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FINAL

FEASIBILITY STUDY
OPERABLE UNIT NO. 19
SITE 84 / BUILDING 45 AREA

MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0219

MAY 2002

Prepared for:

DEPARTMENT OF THE NAVY
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QC Review Page

Feasibility Study Report

OU No. 19, Site 84

MCB Camp Lejeune

Jacksonville, North Carolina

Contract Task Order Number - 0219
Contract Number N62470-95-D-6007
Navy CLEAN II Program

Prepared by

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June 2002

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
AST	Aboveground Storage Tank
Baker	Baker Environmental, Inc.
bgs	below ground surface
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CNO	Chief of Naval Operations
COC	Chemicals of Concern
COPCs	Chemicals of Potential Concern
CSFs	Carcinogenic Slope Factors
CT	Central Tendency
CTO	Contract Task Order
CWA	Clean Water Act
CY	cubic yards
DoN	Department of Navy
DOT	Department of Transportation
DP	direct push
DRO	Diesel Range Organics
ECOC	Ecological Chemicals of Concern
EPH	Extractable Petroleum Hydrocarbon
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
FWENC	Foster Wheeler Enviresponse, Inc.
gpd	gallons per day
GRO	Gasoline Range Organics
HI	Hazard Index
HQ	Hazard Quotient
HQW	High Quality Water
ILCR	Incremental Lifetime Cancer Risk
IP/FP	Implementation Plan/Fee Proposal
IR	Installation Restoration
IRIS	Integrated Risk Information System
IT	International Technology, Inc.
J	Analyte was positively identified, value is estimated
K	Estimated Value, biased high
kg	kilogram

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

L	Estimated Value, biased low
L/day	Liters per day
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
m^3	cubic meters
m^3/kg	cubic meters per kilogram
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCL	Maximum Contaminant Level
MCPA	2-Methyl-4-chlorophenoxyacetic Acid
mg	milligram
mg/kg	milligrams per kilogram
msl	mean sea level
MW	Monitoring Well
NA	Not Applicable
NC	North Carolina
NC DENR	North Carolina Department of Environmental and Natural Resources
NCEA	National Center for Environmental Assessment
NCWQS	North Carolina Water Quality Standards
ND	Not Detected
NE	No Criteria Published
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NSW	Nutrient Sensitive Water
NTCRA	Non-time Critical Removal Action
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OU	Operable Unit
%	percent
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
ppm	parts per million
ppt	parts per thousand
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
R	rejected
RA	Risk Assessment (Human Health)
RAA	Remedial Action Alternative
RAB	Restoration Activity Board
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration (soils)

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

RCRA	Resource Conservation Recovery Act
RF	Receptor Factor
RfCs	Reference Concentrations
RfDs	Reference Doses
RFP	Request for Proposal
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPD	Relative Percent Difference
RRR	Relative Risk Ranking
S	Water Solubility
SARA	Superfund Amendments and Reauthorization Act
SB	Soil Boring
SC	salt waters protected for secondary recreation, fishing, aquatic life including propagation and survival
SDWA	Safe Drinking Water Act
SERA	Screening-Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SOW	Statement of Work
SSL	sediment screening level
SSV	Sediment Screening Value
SSSV	Surface Soil Screening Value
SVE	Soil Vapor Extraction
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TB	Trip Blank
TBC	To Be Considered
TCA	1,1,1-Trichloroethane
TCE	Trichloroethane
TCL	Target Compound List
TCRA	Time Critical Removal Action
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
TP	test pit
TPH	Total Petroleum Hydrocarbons
U	analyte was not detected
UCL	upper confidence limit
UJ	non-detected compound that had inaccurate or imprecise quantitation limits
µg/kg	micrograms per kilogram
µg/L	micrograms per Liter
USC	United States Code
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons
WMPES	Wellhead Management Program Engineering Study
WQS	Water Quality Standard

EXECUTIVE SUMMARY

The objectives of this Feasibility Study (FS) are to identify and evaluate a set of remedial action alternatives (RAAs) to address environmental concerns at Site 84. The RAAs developed and evaluated for Site 84 are effective in protecting human health and the environment and in attaining federal and state requirements that are applicable or relevant and appropriate (ARARs). A wide range of potential RAAs is presented and evaluated that represent various levels of cleanup, costs, and potential future land use considerations.

Site Background and History

Site 84 is located just south of Highway 24 on the main side of Marine Corps Base (MCB), Camp Lejeune, and one mile west of the main gate entrance. The site is partially fenced to prevent vehicular access from Highway 24. The northern edge of the study area borders Highway 24 and the northwest edge is bordered by Northeast Creek. The site extends to the south and west to encompass the former Building 45, and a small, possibly man-made lagoon. Several underground storage tanks (USTs) formerly were present at the site, but have been removed. The site is mostly wooded or covered by thick vegetation or grass in the areas near the creek.

Building 45 is a former electric substation, where transformers reportedly containing polychlorinated biphenyls (PCBs) were known to be used and possibly stored. In addition, approximately 20 transformers potentially containing PCB transformer oil were discovered and removed from the lagoon. Based upon the site history, as reported by maintenance personnel, the lagoon was used to contain discharges from the former Building 45. A 12-inch diameter concrete pipe discharged from the former Building 45 into the lagoon.

Although wetlands have not been delineated at Site 84 by an actual wetland delineation survey, the area along Northeast Creek and west of the lagoon is classified as a wetland based upon the National Wetlands Inventory maps. This classification identifies the wetland as Palustrine in a forested area with broad-leaved deciduous trees. The water regime for the wetland is non-tidal and is only seasonally flooded.

The site is characterized by unconsolidated sands, silts and/or clay. The initial several inches of cover is brown topsoil underlain by fine-grained brown sand. The underling layer is composed of fine-grained sand that extends at least as deep as 20 feet in the southern portions of the site. Throughout the sand layer, varying degrees of silt and perhaps traces of clay are also present. During the site investigation, the groundwater table was encountered from several inches up to 15 feet below ground surface. Groundwater flows to the northwest, towards Northeast Creek.

Based on site investigations conducted to date, including the most recent Remedial Investigation (Baker, 2002a), soil and groundwater are the environmental media of concern for this FS. Soil contaminants of concern include polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and to a lesser extent, total petroleum hydrocarbons (TPHs), and pesticides. Groundwater contaminants that exceed screening criteria include volatiles, inorganics and pesticides. Although shallow groundwater is contaminated, shallow groundwater is not used at Camp Lejeune as a potable water source.

Remedial actions conducted to date at Site 84 have included removal and closure of two leaking USTs in October 1992 and the subsequent installation and operation of an air sparging and soil vapor extraction (SVE) system near the former Building 45 for the remediation of petroleum-contaminated soil and groundwater associated with the USTs. Although the petroleum contamination in groundwater is being remediated by the on-going air sparging/SVE system under the UST Program, petroleum related constitutents in groundwater are addressed in this FS.

In addition, a non-time-critical removal action (NTCRA) is planned for removal of the Building 45 foundation and surrounding contaminated soils. The NTCRA is scheduled for the summer of 2002. Contaminated soil associated with the former USTs and the Building 45 NTCRA are addressed by other remedial actions and are therefore excluded from this Feasibility Study.

Remediation Goals

The remediation goals for chemicals of concern (COCs) at Site 84 were selected based on regulatory requirements, standards, and guidance, and future land use considerations for Site 84. Selected remediation goals for high-occupancy, low-occupancy, and recreational land use for Site 84 and the basis for each remedial goal are provided below.

High-Occupancy Land Use

High-occupancy land use is defined as a land use where an unprotected individual may be present for more than an average of 6.7 hours/week, or 335 hours/year. Examples of high-occupancy land use include a residence, school, or office building.

The selected remediation goal for PCBs for high-occupancy land use is 1.0 ppm without additional engineering or land use controls and is 10 ppm under a capping scenario. Remediation goals of 10 ppm for TPH Gasoline-Range Organics (GRO) and 40 ppm for TPH Diesel-Range Organics (DRO) were selected as stipulated by the North Carolina UST Program. For a high-occupancy land use scenario, remediation goals for PAHs/pesticides are the United States Environmental Protection Agency (USEPA) Region IX Residential Preliminary Remediation Goals (PRGs).

Low-Occupancy Land Use

Low-occupancy land use is defined as a land use where an unprotected individual would not be present for more than an average of 6.7 hours/week, or 335 hours/year. Examples of low-occupancy land use include a storage facility, non-office warehouse, or electrical substation.

The selected remediation goal for PCBs for low-occupancy land use under TSCA is 25 ppm without additional engineering or land use controls, 50 ppm when the site is secured with fencing and signs, and 100 ppm under a capping scenario. The EPA Office of Solid Waste and Emergency Response (OSWER) recommends 10 ppm for an industrial land use scenario. Remediation goals of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program. For a low-occupancy land use scenario, remediation goals for PAHs/pesticides are the EPA Region IX Industrial PRGs.

Recreational Land Use

Recreational land use is defined as a land use where an unprotected individual may be present for recreational purposes. Examples of recreational land use would include boating, fishing, or a community park.

The selected remediation goals for recreational land use are site-specific, risk-based goals for PCBs/PAHs/pesticides that are designed to be protective of recreational users of the site. Remediation goals of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program.

Remedial Action Objectives

Remedial action objectives are medium-specific or site-specific goals established for protecting human health and the environment. At Site 84, the environmental media to be addressed by remedial actions proposed in this FS include groundwater, contaminated soils in certain areas of the site, and contaminated sediments in the lagoon area. Remedial action objectives for Site 84 are:

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *high-occupancy land use* (e.g., residence, school, or office), OR

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *low-occupancy land use* (storage area, non-office warehouse, or electrical substation), OR

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *recreational land use.* (e.g., marina, fishing, boating, swimming)

- Protect human health by mitigating the potential for exposure to the contaminated surficial aquifer.

- Backfill the lagoon, which is considered a potential physical hazard at the site.

Soil Remedial Action Alternatives (RAAs)

The soil RAAs that were developed and evaluated in this Feasibility Study for Site 84 represent a wide range of response actions, remediation goals, potential land uses, land use controls, and

remediation costs. A summary table that presents a description, allowable land uses, land use controls required, remediation goals, and remediation costs for each soil RAA is provided as Table ES-1. Currently, the site is not used and public access is restricted. Future land use for the site has not been definitively determined, therefore, soil remedial alternatives are developed that would allow for recreational land uses such as a marina or community park, high-occupancy land uses such as housing or offices, and low-occupancy land uses such as for an electrical substation or warehouse/equipment storage. Except for the no action RAA, each RAA is protective of human health and the environment for its intended future land use (high-occupancy, low-occupancy, or recreational). The soil RAAs are listed below and are followed by a brief description and evaluation of each RAA.

- RAA 1: No Action
- RAA 2: Excavation and Landfill Disposal (High-Occupancy Land Use, No Access Restrictions)
- RAA 2a: Excavation and Landfill Disposal (High-Occupancy Land Use, Access Restrictions)
- RAA 3: Excavation and Capping (High-Occupancy Land Use, No Access Restrictions)
- RAA 3a: Excavation and Capping (High-Occupancy Land Use, Access Restrictions)
- RAA 4: Excavation and Landfill Disposal (Low-Occupancy Land Use)
- RAA 5: Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)
- RAA 6: Hot Spot Removal and Fencing (Low-Occupancy Land Use)
- RAA 7: Hot Spot Removal and Capping (Low-Occupancy Land Use)
- RAA 8: Excavation and Landfill Disposal (Recreational Land Use, No Access Restrictions)
- RAA 8a: Excavation and Landfill Disposal (Recreational Land Use, Access Restrictions)

The high-occupancy and recreational land use RAAs include two scenarios. The first scenario is a "no access restrictions" scenario and involves removal or capping of all soil on the site that contains contaminants in exceedance of the remedial goals. The second scenario is an "access restrictions" scenario that involves removal or capping of contaminated soil within the open areas of the site, but includes fencing to restrict access to the wetland/wooded areas in the northwest corner of the site such that this wetland/wooded area does not have to be destroyed by excavation or capping remedial actions. The goals of this second scenario are to reduce remediation costs, preserve wetlands and wildlife habitats, and improve site aesthetics.

RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to reduce the toxicity, mobility, or volume of contaminants identified in soil at Site 84. In addition, no land use controls or land use restrictions will be implemented at the site. Vehicular access by the general public is currently partially restricted by existing fencing along the highway. The no action alternative is not protective of human health and the environment, but is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide a baseline for comparison with other RAAs that provide a greater level of response.

RAA 2: Excavation and Landfill Disposal (High-Occupancy Land Use, No Access Restrictions)

RAA 2 is recommended for high-occupancy future land uses. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for high-occupancy land use with no additional controls. Under the "no access restrictions" option, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed, including impacted wetland and wooded areas that are costly to clear and excavate. Confirmatory sampling would be conducted to ensure that all contaminants exceeding remediation goals have been excavated.

Toxic Substances Control Act (TSCA)-regulated soils (PCBs greater than 50 ppm) would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions. As excavation of the wetland area would

destroy the wetland, this RAA would require wetland restoration under the Clean Water Act. Under this option, no further land use controls would be necessary.

RAA 2a: Excavation and Landfill Disposal (High-Occupancy Land Use, Access Restrictions)

RAA 2a is the same as RAA 2, but with access restrictions added. An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site to restrict access to this wetland/wooded area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on this portion of the site. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

Land use controls for this "access restrictions" option would include permanent access restrictions to the fenced wooded/wetland area, which would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented.

RAA 3: Excavation and Capping (High-Occupancy Land Use, No Access Restrictions)

RAA 3 is recommended for high-occupancy future land uses. This RAA will include the installation of a soil cover over the contaminated soils that exceed remediation goals for high-occupancy land use with capping.

Under the "no access restrictions" option, all soil and lagoon sediments exceeding high-occupancy cleanup criteria would be capped, while soil and lagoon sediments containing >10 ppm PCBs would be excavated and removed. Confirmatory sampling will take place to ensure that all contaminants exceeding 10 ppm for PCBs have been excavated. Under this option, impacted wetland and wooded areas, that are costly to clear and excavate, would be included in the capping or excavation process. As excavation or capping of the wetland area would destroy the wetland, this RAA option would require wetland restoration under the Clean Water Act.

The total area at Site 84 to be capped with a soil cover for a future high-occupancy land use for the "no access restrictions" scenario is approximately 3.9 acres. The soil cover will consist of 12 inches of clean backfill and six inches of topsoil. The cap will be contoured so as to control erosion and sedimentation, and will be compacted and vegetated with native grasses and plant species. The cap will be inspected on an annual basis and after major storm events to ensure that integrity is maintained.

Because contaminated soil that poses a potential human health risk will remain at the site, land use controls will be required for this alternative. Land use controls will include restrictions on intrusive activities at the site (e.g., excavation, installation of wells, or construction) other than for monitoring or future remediation purposes.

RAA 3a: Excavation and Capping (High-Occupancy Land Use, Access Restrictions)

RAA 3a is the same as RAA 3, but with access restrictions added. An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site to restrict access to this wetland/wooded area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on this portion of the site. The total area at Site 84 to be capped with a soil cover under the "access restrictions" scenario is reduced to approximately 3.2 acres. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

Similar to RAA 3, land use controls would include restricting intrusive activities at the site (e.g., excavation, installation of wells, or construction) other than for monitoring or future remediation purposes. In addition, under the "access restrictions" option, land use controls would also include permanent access restrictions to the fenced wooded/wetland area and this area would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented.

RAA 4: Excavation and Landfill Disposal (Low-Occupancy Land Use)

RAA 4 is recommended for low-occupancy future land uses such as a non-office warehouse, equipment storage facility, or an electrical substation. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use. Remediation goals for this RAA include North Carolina UST regulations cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), EPA cleanup goals for PCBs for low-occupancy areas (10 ppm), and EPA Region IX Residential PRGs for other contaminants

Under this RAA, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. Confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for PCBs, PAHs, pesticides, and TPH. Excavated soils would be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be handled separately and would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions.

Because contaminated soil remaining on site could pose a potential human health risk, land use restrictions will be required for this alternative. Future land use will be restricted to low-occupancy uses. A fence will be installed around the site perimeter to protect recreational trespassers. Although TSCA low-occupancy cleanup levels for no additional controls will be used for RAA 4, PCBs in excess of recreational goals will remain on site. A fence to protect recreational users is therefore conservative, but recommended. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted.

RAA 5: Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)

RAA 5 is recommended for low-occupancy future land uses. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use with no additional controls. All soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. Confirmatory sampling would be conducted to ensure that all contaminants exceeding remediation goals have been excavated. Following the excavation operation, the site would be restored to its pre-excavation conditions.

Because contaminated soil poses a potential human health risk, and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-occupancy uses. A fence will be installed around the site perimeter to protect recreational trespassers. Although TSCA low-occupancy cleanup levels for no additional controls will be used for RAA 5, PCBs in excess of recreational goals will remain on site. A fence to protect recreational users is therefore conservative, but recommended. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted.

RAA 6: Hot Spot Removal and Fencing (Low-Occupancy Land Use)

RAA 6 is recommended for low-occupancy future land uses. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use with site fencing. All soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. Confirmatory sampling would be conducted to ensure that all contaminants exceeding remediation goals have been excavated. Following the excavation operation, the site would be restored to its pre-excavation conditions.

Site access restrictions will include fencing to reduce exposure pathways by limiting access of potential recreational trespassers to the site and posted signs to inform individuals of the potential site hazards. A fence will be constructed and signs posted along the entire site perimeter.

Because contaminated soil poses a potential human health risk, and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-occupancy uses. In addition, certain types of activities at the site, such as intrusive activities (e.g.,

excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted.

RAA 7: Hot Spot Removal and Capping (Low-Occupancy Land Use)

RAA 7 is recommended for low-occupancy future land uses. This RAA will include the installation of a soil cover over the contaminated soils that exceed remediation goals for low-occupancy land use with capping. The total area at Site 84 to be capped with a soil cover for this RAA is approximately 1.4 acres. The soil cover will consist of 12 inches of clean backfill and six inches of topsoil. The cap will be contoured so as to control erosion and sedimentation, and will be compacted and vegetated with native grasses and plant species.

The soils with a PCB concentration above 100 ppm must be excavated prior to capping as they exceed the TSCA cleanup level for low-occupancy land use with a cap. During excavation, field screening will be conducted to ensure that all soils exceeding 100 ppm PCBs are removed. Following the excavation operation, the site would be restored to its pre-excavation conditions.

Because contaminated soil poses a potential human health risk, and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-occupancy uses. The entire site perimeter will be fenced to protect potential recreational trespassers. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted.

RAA 8: Excavation and Landfill Disposal (Recreational Land Use, No Access Restrictions)

RAA 8 is recommended for recreational future land uses. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for recreational land use. Under the "no access restrictions" option, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed, including impacted wetland and wooded areas that are costly to clear and excavate. Confirmatory sampling would be conducted to ensure that all contaminants exceeding remediation goals have been excavated.

TSCA-regulated soils (PCBs greater than 50 ppm) would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal.

The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions. As excavation of the wetland area would destroy the wetland, this RAA option would require wetland restoration under the Clean Water Act. Under this option, no land use controls would be necessary.

RAA 8a: Excavation and Landfill Disposal (Recreational Land Use, Access Restrictions)

RAA 8a is the same as RAA 8, but with access restrictions added. An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site to restrict access to this wetland/wooded area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on this portion of the site. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

Land use controls for this "access restrictions" option would include permanent access restrictions to the fenced wooded/wetland area, which would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented.

Groundwater Remedial Action Alternatives (RAAs)

The surficial aquifer at the site is not used as a potable water supply and it is unlikely that it will be used as a potable water supply in the future. Nonetheless, the surficial aquifer contains volatile, inorganic and pesticide constituents that exceed federal and/or state standards. Therefore, groundwater RAAs are developed to address this issue. A summary table that presents a description, land use controls required, and costs for each groundwater RAA is provided as Table ES-2. The groundwater RAAs are listed below and are followed by a brief description and evaluation of each RAA.

GW RAA 1: No Action

Under the no action GW RAA, no physical remedial actions will be performed, no groundwater monitoring will be conducted, and no aquifer use restrictions will be implemented at the site. The no action alternative is required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide a baseline for comparison with other RAAs that provide a greater level of response.

GW RAA 2: Groundwater Monitoring and Institutional Controls

Under GW RAA 2, a groundwater monitoring program would be implemented at Site 84 to confirm the presence of VOCs and pesticides that were each detected at low levels in two monitoring wells and to evaluate whether the metals that were detected in twelve wells at low levels, but above screening criteria, are indicative of background concentrations typically found at MCB Camp Lejuene.

A short-term monitoring program, consisting of four additional groundwater sampling events, is proposed at this time under this alternative. If the results of this short-term monitoring program indicate that pesticides or VOCs are still present at the site above screening criteria and/or that metals are present above Base background concentrations, then a focused long-term sampling program may be warranted. Aquifer use restrictions will be implemented to prohibit future use of the aquifer in the vicinity of Site 84 for potable purposes until it can be shown in four consecutive rounds of sampling that the selected COCs are below remedial goals or base background levels.

1.0 INTRODUCTION

Marine Corps Base (MCB) Camp Lejeune was placed on the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) National Priorities List (NPL) effective November 4, 1989 (54 Federal Register 41015, October 4, 1989). Subsequent to this listing, the United States Environmental Protection Agency (USEPA) Region IV, the North Carolina Department of Environment and Natural Resources (NC DENR), the Department of Navy (DoN) and the Marine Corps entered into a Federal Facilities Agreement (FFA) for MCB, Camp Lejeune. The primary purpose of the FFA is to ensure that environmental impacts associated with past and present activities at the Base are thoroughly investigated, and that appropriate CERCLA response and Resource Conservation Recovery Act (RCRA) corrective action alternatives are developed and implemented as necessary to protect the public health and welfare, and the environment (MCB, Camp Lejeune FFA, 1991).

The fiscal year 2002 Site Management Plan for MCB, Camp Lejeune, a primary document referenced in the FFA, identifies 42 sites that require Remedial Investigation/Feasibility Study (RI/FS) activities. These 42 sites have been divided into 21 Operable Units (OUs). Operable units are formed as an incremental step toward addressing individual site concerns and to simplify the specific problems associated with a site or group of sites. This report describes the Feasibility Study (FS) conducted at OU No. 19, which is comprised of Site 84. As shown on Figure 1-1, Site 84 is located near the center of the northern border of MCB, Camp Lejeune.

This FS has been prepared by Baker Environmental, Inc. (Baker) for the DoN, Atlantic Division Naval Facilities Engineering Command, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program. Activities associated with this FS have been conducted in accordance with the requirements delineated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) 300.430] for OU No. 19 at MCB, Camp Lejeune, North Carolina. The NCP guidelines that dictate the FS process were promulgated under CERCLA, commonly referred to as Superfund, and amended by the Superfund Amendments and Reauthorization Act (SARA). The USEPA document entitled Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988) provided guidance during the preparation of this report.

1.1 Report Purpose and Organization

The subsections that follow describe the purpose and organization of this FS report.

1.1.1 Purpose of the Feasibility Study

The primary purpose of the FS report for Site 84 is to identify the remedial alternatives that are protective of human health and the environment, and that cost-effectively attain appropriate federal and state requirements that are applicable or relevant and appropriate (ARARs). In general, the FS process under CERCLA serves to ensure appropriate remedial alternatives are developed and evaluated, such that pertinent information concerning the remedial action options can be presented and an appropriate remedy selected. The FS involves two major functions:

1. Development and screening of remedial action alternatives, and
2. Detailed analysis of remedial action alternatives.

The first phase of the FS process includes the following activities:

- Developing remedial action objectives and remediation levels
- Developing general response actions
- Identifying volumes or areas of affected media
- Identifying and screening potential technologies and process options
- Evaluating process options
- Assembling alternatives
- Defining alternatives
- Screening and evaluating alternatives

Section 121(b)(1) of CERCLA requires that an assessment be conducted to investigate possible solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant. In addition, according to CERCLA, treatment alternatives should be developed ranging from an alternative that, to the degree possible, would eliminate the need for long-term management to alternatives that involve treatment that would reduce toxicity, mobility, or volume as their principal element. A

containment option involving little or no treatment and a no-action alternative should also be developed.

The second phase of the FS process consists of:

- Evaluating the potential alternatives in detail with respect to nine evaluation criteria that address statutory requirements and preferences of CERCLA
- Performing a comparison analysis of the evaluated alternatives.

1.1.2 Report Organization

This FS is organized into six sections. The Introduction (Section 1.0) presents the purpose of the report, a brief discussion of the FS process, and pertinent site background information including a summary of the nature and extent of contamination at Site 84. A summary of the human health and ecological risk assessments is presented in Section 2.0. Section 2.0 also includes the remedial action objectives and remediation goals that have been established for this site. Section 3.0 presents the identification of general response actions and preliminary screening of the remedial action technologies and process options. Sections 4.0 and 5.0 contain the development, detailed analysis, and comparison of remedial action alternatives. The detailed analysis is based on a set of nine criteria including short- and long-term effectiveness, implementability, cost, acceptance, compliance with applicable regulations, and overall protection of human health and the environment. Reference documents are provided in Section 6.0.

1.2 Background Information

This section presents background information pertaining to Site 84. The following subsections include information such as site location and setting, geology, hydrogeology and surface water hydrology. Further information of this type for Site 84 can be found in the Final Project Plans (Baker, 2001b) and Final Remedial Investigation (Baker, 2002a).

1.2.1 Site Location and History

Site 84 is located just south of Highway 24 on the main side of MCB, Camp Lejeune, one mile west of the main gate entrance (Figure 1-1). A map indicating site features is presented as Figure 1-2. Vehicular access to the site is limited along Highway 24 by a chain link fence. The northern

edge of the study area borders railroad tracks and Highway 24, and the northwest edge is bordered by Northeast Creek. The area of impact extends to the south and west to encompass the foundation of the former Building 45, and a small, man-made lagoon, respectively. The site is mostly wooded or covered by thick vegetation or grass in areas near the creek. An access road runs through the site and terminates at Northeast Creek.

The former Building 45 was an electric substation, where transformers reportedly containing polychlorinated biphenyls (PCBs) were known to be used and possibly stored. A transformer was discovered in the wooded area, east of the substation. Additional transformers (approximately 20) potentially containing PCB transformer oil were discovered and removed from the lagoon. Maintenance personnel at the former Building 45 have indicated that additional transformers may still be buried in areas near the lagoon; however, it was reported that public works had performed minor excavations in the area and did not discover any buried materials. Historical drawings regarding the original layout of the former Building 45 are provided in the RI report (Baker, 2002a).

Based upon site history as dictated by maintenance personnel at the former Building 45, the lagoon was used to contain discharges from the former Building 45. A 12-inch diameter concrete pipe discharged into the southeastern end of the lagoon. Conversations with Base personnel indicate that the pipe is connected to the oil/water separator located outside of the former Building 45. However, it is believed that prior to the installation of the oil/water separator, the pipe was connected directly to the building floor drains.

1.2.2 Geology

In general, the subsurface lithology in the vicinity of the Site 84 changes toward the direction of Northeast Creek. The two cross sections described below were developed as part of the RI to aid in the characterization of the geology and hydrogeology of Site 84. These cross-sections are presented in the RI Report (Baker, 2002a).

Cross-section A-A' trends northwest to southeast and passes through the Building 45 foundation. This section illustrates the lithologic sequence of Site 84. Fine sand (of the undifferentiated formation) predominates in this section. Fill material (i.e., fine sand, coal and brick fragments) is present in the vicinity of the Building 45 foundation at a depth of approximately 2 feet. The fill material extends approximately 150 feet northwest of the foundation.

Cross-section B-B' trends southwest to northeast and passes just northwest of the Building 45 foundation. Like Section A-A', fine sand (of the undifferentiated formation) predominates in Section B-B'. Fill material (i.e., fine sand, gravel and brick fragments) is present in the vicinity of Building 45 foundation at depth of approximately 2 feet. The fill material extends from the building foundation approximately 95 feet southwest of the foundation. The fill material was not observed at well 84-MW16 (110 feet northeast of the foundation). A sequence of fine sand/clay was observed at well 84-MW16 at depths of 14 to 14.6 and 16 to 18 feet. This fine sand/clay layer pinches out between 84-MW16 and 84-MW22.

Site 84 soils are members of the Muckalee-Dorovan soil association. Muckalee soils are poorly drained loam underlain by sandy loam and loam. The surface soils are strongly acidic and the subsoil can range from moderately acid to alkaline. Muckalee soils were formed from non-acidic parent material that was rich in calcium carbonate. Dorovan soils are muck that is very poorly drained and strongly acidic. Dorovan soils have a high content of organic materials. Dorovan soils have formed by the accumulation of organic debris.

As distance increases from Northeast Creek at Site 84, the soil transitions in to the Baymeade-Foreston-Stallings soil association. Baymeade soils are well drained fine sands underlain by fine sandy loam subsoil that is gently sloping or nearly level. Baymeade soils are moderately to highly acidic. Foreston soils are found on slightly convex divides, are well drained, strongly acidic, loamy fine sands with a fine sandy loam subsoil. Stallings soils are poorly drained, strongly to extremely acidic, loamy fine sands over fine sandy loam in interstream areas.

1.2.3 Hydrogeology

During advancement of the borings, groundwater was encountered from several inches to 15 feet below ground surface (bgs). Static water elevations measured on August 7, 2001 for the 12 monitoring wells sampled as part of the RI field investigation were used to generate a groundwater contour flow map of the surficial aquifer, presented in Figure 1-3. As indicated on the figure, shallow groundwater flows to the northwest, towards Northeast Creek.

In-situ hydraulic conductivity (slug) tests were conducted on select wells at Site 84 to provide an estimate of hydraulic conductivity of the surficial aquifer. The hydraulic conductivity values of the Site 84 upper superficial aquifer exhibited high variability between tested wells ranging from 0.48 feet/day (1.7×10^{-4} cm/sec) at well 84-MW19 to 16 feet/day (5.6×10^{-3} cm/sec) at well 84-

MW09. The lower conductivities (0.48 to 1 feet/day) were observed at the wells adjacent to the Building 45 foundation (84-MW16, 84-MW18 and 84-MW19). The higher conductivities (11.2 and 16 feet/day) were observed at the existing wells 84-MW07 and 84-MW09.

Groundwater velocities in the vicinity of the Building 45 foundation (higher horizontal gradient) averaged 0.13 feet/day (approximately 47 feet/year) in the upper surficial aquifer. Groundwater velocities west of the building 45 foundation (lower horizontal gradient) averaged 0.2 feet/day (73 feet/year).

Water supply wells within a one-mile radius of Site 84 were identified by reviewing information provided by the Base. A total of 15 supply wells were identified within a one-mile radius of the study area, of which six are currently in service. These wells are identified in Figure 3-9 of the RI Report (Baker, 2002a).

1.2.4 Surface Water Hydrology

Site 84 is bordered to the northwest by Northeast Creek. The creek is a large tributary to the New River. The classification of Northeast Creek from State Highway 24 downstream to the mouth of Scales Creek (the area adjacent to Site 84) is SC HQW NSW. This classification is defined as salt waters protected for secondary recreation, fishing, aquatic life including propagation and survival (SC) that are nutrient sensitive (NSW) and of high quality (HQW). From the mouth of the Scales Creek downstream to the New River (downstream of Site 84), Northeast Creek is classified as SC NSW. These downstream waters are similar to the waters upstream of Scales Creek, however they are not considered high quality waters. These classifications are published under Title 15 of the North Carolina Administration Code. The salinity of Northeast Creek as measured on November 15, 2001 was 22.3 parts per thousand (ppt). This salinity reading agrees with the classification of the creek as a saltwater body.

A lagoon, approximately 75 to 85 feet in diameter, is located within the wooded area southwest of the road leading to Northeast Creek. Water levels in the lagoon have decreased since initial field investigations at the site, presumably due to the discontinuation of use of the drainage pipe leading from the former Building 45. The depth of water in the lagoon during a November 2001 site visit was estimated to be approximately 2 feet. The lagoon banks extend approximately 5 feet above the water level. A narrow area on the southeast edge of the lagoon was cleared of vegetation in July 2001 as a result of trenching activities to locate a buried pipe.

Although wetlands have not been delineated at Site 84 by an actual wetland delineation survey, the area along Northeast Creek and west of the lagoon is classified as a PF0411C wetland based upon the National Wetlands Inventory (NWI) maps for the MCB, Camp Lejeune area. The wetland boundary is indicated on Figure 1-2. This classification identifies the wetland as Palustrine in a forested area with broad-leaved deciduous trees. The water regime for the wetland is non-tidal and is only seasonally flooded.

1.3 Previous Investigations

The following subsections provide information concerning the previous investigations completed at Site 84. The information is summarized to provide the reader with an overview of site investigations conducted to date.

Investigations that have taken place at Site 84 have been reported in the following documents:

- UST Site Check Investigation Report, Building 45, UST S-941-2 (ATEC Associates, Inc., 1992)
- Site Assessment, Tank S741, Midway Park (O'Brien and Gere, 1992)
- Five well site check and resample one existing well (R.E. Wright Associates, Inc., 1994)
- Leaking UST Site Assessment Report, Building 45, UST S-941-2 (Law Engineering, Inc., 1994)
- Relative Risk Ranking System Data Collection Investigation (Baker Environmental Inc., 1995)
- Pre-Remedial Investigation Screening Study (Baker Environmental Inc., 1998a)
- Draft Engineering Evaluation/ Cost Analysis (Baker Environmental, Inc., 1998b)
- GW-UST 12 Report, UST Removal at Building 45 (J.A. Jones, Inc., 1999)
- Trip Report, Site 84 - Building 45 Area (Baker Environmental, Inc., 1999a)

- Draft Action Memorandum, Site 84 - The Building 45 Area (Baker Environmental, Inc. 1999b)

- Concrete Chip and Surface Water Sampling, Building 45 (Baker Environmental, Inc., 1999)

- Final Remedial Investigation, Operable Unit No. 19, Site 84 Building 45 Area (Baker Environmental Inc., 2002a)

Initial investigations at Site 84/Building 45 Area were directed towards underground storage tanks (USTs) associated with the former Building 45. These investigations concentrated on total petroleum hydrocarbon (TPH), volatile organic compounds (VOCs), oil and grease, and halogenated solvent contamination.

Baker's Relative Risk Ranking System Data Collection Investigation (1995) and Pre-RI Screening Study (1998) were predicated on the discovery of transformers in the lagoon and the detection of PCBs in the soil. Surface soil analyses indicated PCB contamination in the area of the lagoon and towards the former Building 45. The highest concentrations of Aroclor 1260 in the surface soil were detected approximately midway between the lagoon and the former Building 45. Groundwater samples were collected from specific existing wells at Site 84. Analyses for PCBs indicated no PCBs above detection limits. Additional analyses for VOCs indicated benzene and chloroform above screening standards. Surface water samples collected from the lagoon where transformers were discovered and removed did not exhibit PCB contamination, but did exhibit BTEX constituent concentrations below screening standards. Sediment samples collected from the lagoon exhibited PCB, VOC, semi-volatile and diesel range organic contamination above screening standards.

Summaries of analytical results from investigations conducted at Site 84 prior to the Remedial Investigation are presented in the RI report (Baker, 2002a). A summary of the RI (Baker, 2002a) and the Pre-RI Screening study (Baker, 1998a) is presented in Section 1.5.

1.4 Non-Time Critical Removal Action

The above ground portions of Building 45 were removed in 1999, with the foundation left in place. A fence was installed along the perimeter of the building foundation. Removal of the foundation and adjacent contaminated soils is planned as a non-time-critical removal action

(NTCRA), and is scheduled to begin in the summer of 2002. A Non-Time Critical Removal Action Performance Specification Report was prepared that details this effort (Baker, 2002b). The NTCRA will address removal of the foundation and a limited amount of impacted soil adjacent to the former Building 45. Figure 1-4 indicates the planned minimum and maximum areas to be excavated.

1.5 Remedial Investigation

The RI field program activities consisted of a soil investigation, trenching to locate a buried pipe and a shallow groundwater investigation. The focus of the soil investigation included the area surrounding the former Building 45 and northeast of the gravel road leading to Northeast Creek, as contamination in other areas had been delineated in previous investigations. Field activities were conducted as two field events. The first event took place from July 16 to July 23, 2001 and the second field event occurred July 30 through August 8, 2001. Data collected during the RI field investigation was combined with Pre-RI data (Baker, 1998) to fully characterize contamination at the site. Sample locations are indicated on Figure 1-5.

1.5.1 Surface and Subsurface Soil Investigation

Surface and subsurface soil samples were collected to assess contamination at Site 84 and to provide lithological information for the evaluation of geologic and hydrogeologic conditions. Soil samples for the RI investigation consisted of direct push (DP) sampling, test pit samples (TP), soil borings (SB), and monitoring well borings (MW).

1.5.1.1 Direct Push Sampling

During the first field event, DP samples were collected from 74 soil borings, including 11 borings advanced around the perimeter of the former Building 45. At each boring, surface soil samples were collected from an interval of 0-1 feet below ground surface (bgs). At soil boring locations drilled with the GeoProbe rig (as opposed to a hand auger), subsurface soil samples were collected at an interval within 6 inches of the top of the water table. Additional subsurface soil samples were collected at intermediate depths if the depth to the water table exceeded 5 feet or if contamination was evident. A total of 127 soil samples were collected from the 74 borings during the first field event. In field EnSys™ PCB field test analyses were used to expand the initial sampling grid to fully delineate the area of contamination. Approximately 30% of the soil

samples were sent to a fixed-base laboratory (Analytics) for confirmatory analysis of PCBs. Eighteen samples collected from the 11 soil boring locations around the perimeter of the former Building 45 were analyzed at the fixed base laboratory for Target Compound List (TCL) VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, Gasoline Range Organics (GRO), Diesel Range Organics (DRO), cyanide, and Target Analyte List (TAL) metals.

During the second field event, eleven direct push locations were sampled. Twenty-two direct push soil samples were collected and sent to the fixed base laboratory for analyses of VOCs, SVOCs, pesticides, PCBs, herbicides, Volatile Petroleum Hydrocarbons (VPH), Extractable Petroleum Hydrocarbons (EPH), and TAL metals. It is noted that as opposed to the first field event, requested analyses during the second event included VPH and EPH and did not include GRO, DRO, or cyanide. These changes were made in response to the Camp Lejeune Partnering Team's decision that petroleum contamination should be delineated at the site in addition to PCB delineation.

1.5.1.2 Test Pit Sampling

Two soil samples were collected from each of three test pit locations along the location of a drainage pipe leading from the former Building 45 to the lagoon. Samples were collected both adjacent to and underneath the pipe. Soil samples collected from test pits were sent to the fixed base laboratory for analysis of PCBs.

1.5.1.3 Soil and Monitoring Well Borings

Eight soil boring samples (all subsurface soils) and 14 monitoring well boring samples (six surface soil and eight subsurface soil samples) were collected during the second field event. These samples were sent to the fixed base laboratory for analyses of TCL VOCs, SVOCs, pesticides, PCBs, herbicides, VPH, EPH and TAL metals.

1.5.1.4 Pre- RI Soil Data

Surface soil data available from the Pre-RI investigation included 20 samples collected in 1995 and 28 samples collected in 1998. These soil samples were analyzed for PCBs.

1.5.2 Groundwater Investigation

In 2001, groundwater samples were collected from 12 monitoring wells including the eight newly installed wells and four existing monitoring wells, each screened in the uppermost portion of the surficial aquifer. Samples were analyzed for TCL VOCs, SVOCs, TAL metals, PCBs, pesticides, herbicides, VPH, and EPH in accordance with Contract Laboratory Program (CLP) protocol. Groundwater data was also available from the Pre-RI (Baker, 1998). In 1995, groundwater was collected from three shallow monitoring wells and was analyzed for PCBs. In 1998, groundwater was collected from six monitoring wells and was analyzed for TCL VOCs.

1.5.3 Surface Water and Sediment Investigation

No surface water or sediment was collected as part of the RI field investigation. Data from the Pre-RI (Baker, 1998) were available for evaluation. In 1995, three surface water and sediment samples were collected from Northeast Creek and four surface water and sediment samples were collected from the lagoon. All samples were analyzed for PCBs. In 1998, seven surface water and four sediment samples were collected from the lagoon. Six of the surface water samples were analyzed for PCBs and the seventh was analyzed for TCL VOCs and SVOCs. Three of the sediment samples were analyzed for DRO, pH, percent moisture, and PCBs and the fourth sediment sample was analyzed for TCL VOCs, SVOCs, pH, and percent moisture.

1.6 Nature and Extent of Site Contamination

This section characterizes the nature and extent of contamination at Site 84. This characterization was accomplished by specific laboratory analysis and field screening of environmental samples including soil, groundwater, surface water, and sediments. A complete summary of the analytical data, including a comparison of site data to established standards and/or criteria, is included in the RI Report (Baker, 2002a).

The data are summarized by media in the following subsections as listed below:

- Surface
- Subsurface soils
- Test pits
- Groundwater

- Surface water
- Sediment

1.6.1 Surface Soil

Surface soil analytical data are screened using USEPA Region IX Residential Preliminary Remediation Goals (PRGs) to assess which contaminants require further consideration. Inorganic constituents were screened using Base background data from the Base Background Study completed in April 2001 (Baker, 2001a). Inorganic concentrations exceeding both the PRG and Base background require further consideration.

PCB Analytical Data

A total of 95 surface soil samples were analyzed at a fixed based laboratory for PCBs. Twenty of the samples were collected in October of 1995, 28 samples in March of 1998, and 47 samples (including 5 duplicates) between July and August 2001.

Aroclor-1260 was detected in 68 of 95 samples, at concentrations ranging from 18 J to 200,000 micrograms per kilogram (µg/kg). The PRG for Aroclor-1260 is 220 µg/kg, which was exceeded in 55 samples. The highest detection of Aroclor-1260 was in sample IR84-SB27-01 where the concentration was 200,000 µg/kg. Other significant detections were found in samples IR84-MW20-00 at 11,000 J µg/kg, IR84-DP18-00 at 25,000 µg/kg, IR84-DP82-00 at 11,000 µg/kg, 84-SB01A at 12,000 µg/kg, 84-SB02B at 12,000 µg/kg and 84-SB09A at 12,000 µg/kg.

Other PCB isomers were detected in surface soil samples, but in far fewer samples and generally at lower concentrations. Aroclor-1248 was detected in 4 of 95 samples, ranging from 56 µg/kg to 160,000 µg/kg and Aroclor-1254 was detected in only one sample at 51,000 µg/kg.

Immunoassay Field Screening Results

The majority of the immunoassay results were between 1 ppm and 10 ppm, representing a general area of low level contamination northwest of the Building 45 foundation. This area includes the former AST S-781, and extends toward, and includes a portion of the wetland area to the north of the site (in the vicinity of DP-71). A steep bank leading up to railroad tracks is located immediately north of DP-71 preventing migration of surface contaminants in this portion of the

site. There were two surface soil samples located near the surface drainage feature with results greater than 50 ppm, IR84-DP32-00 and IR84-DP64-00, as shown on Figure 2-4 and indicated in red. There were several areas with sample concentrations between 10 ppm and 50 ppm. One of these areas is located along the drainage pipe that runs from the building to the lagoon. Another area is located at the end of a surface drainage feature.

Volatile Organic Compounds

Twenty-six surface soil samples were analyzed for VOCs. Only acetone, 2-butanone, ethylbenzene, and xylenes were positively detected. No detected VOCs in surface soil exceeded the PRG.

Semi-volatile Organic Compounds

Twenty-six samples were analyzed for SVOCs. There were a total of 21 SVOCs detected in the surface soil samples. Nine of 21 SVOCs exceeded the screening criteria. The PRG was exceeded for a class of SVOCs known as polynuclear aromatic hydrocarbons (PAHs), which include the following compounds (ranges of detection in parentheses):

Benzo(a)anthracene (520 µg/kg to 190,000 µg/kg)	PRG = 620 µg/kg
Benzo(a)pyrene (470 µg/kg to 150,000 µg/kg)	PRG = 62 µg/kg
Benzo(b)fluoranthene (540 µg/kg to 170,000 µg/kg)	PRG = 620 µg/kg
Benzo(k)fluoranthene (340 J µg/kg to 120,000 µg/kg)	PRG = 6,200 µg/kg
Chrysene (560 µg/kg to 180,000 µg/kg)	PRG = 62,000 µg/kg
Dibenz(a,h)anthracene (70 J µg/kg to 17,000 J µg/kg)	PRG = 62 µg/kg
Indeno(1,2,3-cd)pyrene (250 J µg/kg to 59,000 µg/kg)	PRG = 620 µg/kg

Pesticides

There were twenty-four samples that were collected at Site 84 and analyzed for pesticides. Six of 14 pesticides analyzed for were detected above the PRG including:

- 4,4'-DDD (3.2 J µg/kg to 3,000 µg/kg) PRG = 2,400 µg/kg
- Dieldrin (3.5 J µg/kg to 320 µg/kg) PRG = 30 µg/kg
- Heptachlor (1.5 J µg/kg to 22,000 µg/kg) PRG = 110 µg/kg

- Heptachlor epoxide (4.2 J µg/kg to 4,500 µg/kg) PRG = 53 µg/kg
- alpha-Chlordane (2 J µg/kg to 48,000 J µg/kg) PRG = 1,600 µg/kg
- gamma-Chlordane (3.9 µg/kg to 58,000 µg/kg) PRG = 1,600 µg/kg

Inorganics

A total of 26 surface soil samples were analyzed for inorganics with 22 constituents detected in surface soil samples. No detected inorganics exceeded the Region IX PRGs.

Total Petroleum Hydrocarbons (TPH)

TPH was analyzed in 11 surface soil samples collected during the RI. TPH diesel-range organics (TPH-DRO) were detected in all 11 samples with concentrations ranging from 7 J mg/kg to 470 mg/kg. TPH gasoline-range organics (TPH-GRO) were detected in one sample at 0.88 mg/kg.

The highest detection of TPH was located along the former Building 45 (sample IR84-DP46-00), where TPH-DRO was detected at 470 mg/kg. Other surface soil detections of TPH-DRO ranged from 130 mg/kg to 340 mg/kg. TPH-GRO was not detected in high concentrations in the surface soil at Site 84.

1.6.2 Subsurface Soil

Like surface soil, subsurface soil analytical data are screened using Region IX PRGs for Residential Soils to assess which contaminants require further consideration. Inorganics were screened using Base background data. Inorganic concentrations exceeding both the PRG and Base background require further consideration.

PCB Analytical Data

A total of 39 subsurface soil samples were analyzed for PCBs by a fixed based laboratory. Multiple Aroclor isomers were detected in 13 of these samples. Aroclor-1248 was detected at 47,000 µg/kg in sample IR84-DP47-01, which exceeds the PRG. Aroclor-1245 was detected in sample IR84-DP46-02 at 5,000 µg/kg, which also exceeded the PRG. Aroclor-1260 was detected in the other 11 samples, ranging in concentration from 13 J µg/kg to 45,000 µg/kg. Five of these

values exceeded the Region IX PRG Residential Soil screening level (ranging from 1,100 µg/kg to 45,000 µg/kg) with the highest detected concentration in sample IR84-DP18-02.

Immunoassay Field Screening Results

Five subsurface soil samples were screened for PCBs using an immunoassay field test kit. One of the samples, IR84-DP18-02 (3-5 ft.) exhibited a concentration greater than or equal to 50 ppm (Figure 2-4). This sample point is located adjacent to the former AST S-781. There were three samples that exhibited PCB concentrations between 10 ppm and 50 ppm. The PCB concentration of the fifth sample (DP-28-01) was less than 1 ppm (the lowest detection limit of the field test kit).

Volatile Organic Compounds

Twenty-four subsurface soil samples were analyzed for VOCs. There were ten VOCs detected in the subsurface soil samples, none of which exceeded PRGs.

Semi-volatile Organic Compounds

Thirty-three samples were collected and analyzed for SVOCs. A total of twenty-two SVOCs were detected, five of which exceeded PRGs. The PRG was exceeded for a class of SVOCs known as PAHs, which include:

- Benzo(a)anthracene (640 µg/kg to 3,000 µg/kg) PRG = 620 µg/kg
- Benzo(a)pyrene (590 µg/kg to 2,600 µg/kg) PRG = 62 µg/kg
- Benzo(b)fluoranthene (68 J µg/kg to 2,800 µg/kg) PRG = 620 µg/kg
- Dibenz(a,h)anthracene (98 J µg/kg to 430 J µg/kg) PRG = 62 µg/kg
- Indeno(1,2,3-cd)pyrene (340 J µg/kg to 1,200 µg/kg) PRG = 620 µg/kg

Pesticides

Eleven pesticides were detected in subsurface soil samples. Four of 14 pesticides analyzed for were detected above the PRG in three samples, including:

- Heptachlor (1.6 J µg/kg to 6,900 µg/kg) PRG = 110 µg/kg
- Heptachlor epoxide (63 J µg/kg and 200 J µg/kg) PRG = 53 µg/kg
- alpha-Chlordane (3.3 µg/kg to 14,000 J µg/kg) PRG = 1,600 µg/kg
- gamma-Chlordane (3.3 µg/kg to 18,000 µg/kg) PRG = 1,600 µg/kg

Inorganics

Thirty-three subsurface soil samples were analyzed for inorganics. A total of twenty-two metals were detected, all at concentrations below the screening criteria.

Total Petroleum Hydrocarbons (TPH)

Eight subsurface soil samples were analyzed for TPH-DRO and TPH-GRO. TPH-DRO was detected in all eight samples, at concentrations ranging from 15 mg/kg to 5,550 mg/kg. TPH-GRO was detected at 580 mg/kg in sample IR84-DP15-03 and at 0.22 mg/kg in sample IR84-DP46-02.

1.6.3 Test Pits

Two soil samples were collected from each of the three test pits located along the length of the drainage pipe leading from the former Building 45 to the lagoon. These samples were analyzed for PCBs and percent solids. Aroclor-1260 was the only detected PCB isomer and was detected in all six samples, at concentrations ranging from 56 µg/kg to 990 µg/kg. Three of the six samples exhibited Aroclor-1260 above the PRG, namely IR84-TP01A, IR84-TP03A and IR84-TP03B.

The purpose of this sampling effort was to determine if the drainage pipe leading from the former Building 45 to the lagoon has leaked. Based on the detection of Aroclor-1260 in all six samples, there is evidence that the pipe has potentially leaked.

1.6.4 Groundwater

Groundwater data were screened against North Carolina Water Quality Standards (NCWQS) and Federal Maximum Contaminant Levels (MCLs).

Organics

There were no detections of PCBs in groundwater sampled in 1995. No other analytes were analyzed in these groundwater samples.

Groundwater collected in 1998 was analyzed for VOCs. A total of six monitoring wells were sampled, which included a shallow and intermediate well cluster at three separate locations. There were low detections of benzene and ethylbenzene at monitoring well cluster MW03 and MW04. The detections of benzene slightly exceeded the NCWQS of 1.0 µg/L, but are below the federal MCL. Ethylbenzene also was detected in each of these monitoring wells; however, the levels were below both state and federal standards. Chloroform was detected at 16 µg/L in monitoring well cluster MW11 and MW12. This concentration exceeds the NCWQS of 0.19 µg/L, but is less than the federal MCL.

In 2001, 14 groundwater samples were collected and analyzed for VOCs, SVOCs, PCBs, herbicides and metals. There were no exceedances of screening criteria for any of the VOCs or SVOCs. Although there were seven pesticides detected in these samples, only two exceeded the MCL and/or NCWQS. Gamma-chlordane exceeded the NCWQS at well 84-MW18. Also, heptachlor epoxide exceeded the NCWQS at well 84-MW20.

Inorganics

A total of 19 metals were detected in groundwater samples collected in August of 2001. All nine detections of aluminum exceeded the MCL. Antimony was detected above the MCL in one sample. All detections of iron exceeded the MCL and NCWQS. Detections of manganese exceeded the MCL and NCWQS in six samples.

1.6.5 Surface Water

During the October 1995 sampling event, seven surface water samples were collected at Site 84 and analyzed for PCBs. Three of the surface water samples were collected from Northeast Creek and four of the surface water samples were collected from the lagoon. PCBs were not detected in any of the surface water samples collected.

Seven surface water samples were collected in March 1998 from the lagoon. Six of the samples were analyzed for PCBs and the seventh was analyzed for VOCs and SVOCs. Again, PCBs were not detected in any of the surface water samples. Several VOCs were detected in the one surface water sample, including acetone at 5.6 J µg/L, benzene at 1.2 J µg/L, toluene at 2.7 J µg/L, and xylenes at 3.5 J µg/L. No SVOCs were detected in the surface water sample.

1.6.6 Sediments

In October 1995, seven sediment samples were collected at Site 84 and analyzed for PCBs. Three of the samples were collected from Northeast Creek and four of the samples were collected from the lagoon. No PCBs were detected in the sediment samples collected from Northeast Creek; however, each of the four samples collected from the lagoon exhibited PCBs. Sediment sample 84-SD05 contained PCB compounds Aroclor-1248 at 2,800 µg/kg and Aroclor-1260 at 20,000 µg/kg. Aroclor-1260 was also detected in samples 84-SD06, 84-SD07, and 84-SD08 at concentrations of 8,100 µg/kg, 17,000 µg/kg, and 3,700 µg/kg, respectively.

During the March 1998 sampling event, three additional sediment samples were collected from the lagoon. Aroclor-1260 was detected at concentrations of 40,000 µg/kg, 5,900 µg/kg, and 4,300 µg/kg in these samples. These concentrations are all above the Region IX PRG for Aroclor-1260 of 220 µg/kg.

1.7 Conclusions of the Remedial Investigation

1. Soils at Site 84 have been impacted by PCBs due to past site operations. PCB contamination is widespread at low concentrations (1-10 ppm); however, there are three "hot spots" of PCB contamination, including the lagoon area, the midfield area (near the former AST), and the Building 45 area.

2. Soils at Site 84 also have been impacted due to past site operations by VOCs, SVOCs, pesticides, TPH, and inorganics. These contaminants are primarily distributed around Building 45 and the former AST. Concentrations of VOCs and TPH are low compared with SVOCs. Concentrations of SVOCs decrease significantly with depth.

3. A non-Time Critical Removal Action (non-TCRA) involving the demolition of the foundation of former Building 45 and excavation of soils in the immediate area of the

foundation is planned. The removal action addresses one of the three "hot spots" for soil at Site 84 and should significantly reduce site risks. Further, the removal action work plan contains provisions for confirmatory sampling to ensure that remedial goals are met in the area of the NTCRA. Although the removal action is focused on removing the remaining portions of Building 45 and impacted soil in that area, all other areas of the site must be addressed. These areas are addressed in this Feasibility Study along with various remedial alternatives.

4. Groundwater sampling completed as part of the RI identified several VOCs, SVOCs, pesticides, herbicides and inorganics. Benzene, chloroform, heptachlor epoxide, and gamma-chlordane exceeded screening criteria in a limited number of samples. It is important to note that groundwater has been impacted by petroleum products in the northeast portion of the site near former Building 45. Free-phase petroleum as well as a significant dissolved phase plume has been identified by previous site investigations. This portion of the site is being addressed by the UST program with an active treatment system, which is operated and maintained by J.A. Jones.

5. Northeast Creek does not appear impacted by past site operations. Contaminants were not detected in surface water or sediment samples from the creek.

6. Lagoon sediments have been impacted due to past site operations by VOCs and PCBs. The presence of these contaminants is most likely related to the drain pipe that runs from the former building to the lagoon, which was apparently used to discharge waste material from the building. In addition, the presence of PCBs may be related to the reported disposal of transformers in the lagoon.

7. The baseline human health RA for Site 84 evaluated current adolescent and adult recreational users, military Base personnel, future adult and child residents, construction workers, and industrial/commercial workers. A summary of the potential risk for soil and groundwater is provided below:

Total risk values calculated at the site indicate potentially unacceptable carcinogenic risk for the current adult recreational users, future adult and child residents, and future industrial/commercial site workers. Aroclor-1260 in soil remaining on site after the non-TCRA was the primary contributor to unacceptable carcinogenic risks for the future residential receptors.

Soil remaining on site after the non-TCRA did not contribute significantly to unacceptable noncarcenogenic adverse health effects for current Base personnel, future adult and child residents, future construction workers, or future industrial/commercial site workers.

Arsenic in the shallow groundwater contributed to potentially unacceptable carcinogenic risk values for the future receptors evaluated for exposure to groundwater. 2-Methyl-4-chlorophenoxyacetic Acid (MCPA), arsenic, iron, and thallium in the shallow groundwater also contributed to unacceptable total site HI values.

8. Based on the ecological risk assessment, PAHs, pesticides, PCBs, and inorganics in surface soils may pose unacceptable risks to the terrestrial ecological community at Site 84. VOCs, SVOCs, and PCBs in lagoon sediments may pose unacceptable risks to ecological receptors using the lagoon. The lagoon area and area along the perimeter of former Building 45 are the most hazardous to ecological receptors at Site 84. Although potential risks to ecological receptors will decrease substantially following the non-TCRA in the vicinity of Building 45, unacceptable risks to terrestrial flora, fauna, and upper trophic level receptors will still exist at the site. After the removal action, potential risk from most surface soil contaminants to terrestrial receptors will be moderate to low; however, Aroclor-1260 will continue to pose substantial risks to the terrestrial community. No unacceptable risks were estimated for surface waters or sediment of Northeast Creek. Pesticides in groundwater may pose unacceptable risks to ecological receptors in Northeast Creek if dilution upon discharge to the creek is negligible; however, potential risks contributed by groundwater are anticipated to be low.

2.0 REMEDIATION GOALS AND REMEDIAL ACTION OBJECTIVES

This section presents a discussion of remediation goal options and remedial action objectives for Site 84. The remediation goal options and remedial action objectives are based on regulatory requirements, standards, and guidance, also referred to as *Applicable or Relevant and Appropriate Requirements (ARARs)* and those *To Be Considered (TBCs),* if available, as well as assessments of current and potential human health risks and future land use considerations for Site 84.

Section 2.1 summarizes the results of the human health risk assessment under current and future land use scenarios. Section 2.2 presents the current and possible future land uses for Site 84 and a discussion of land use controls. Section 2.3 describes the media of concern and a discussion of contaminants of concern (COCs) at Site 84. Section 2.4 provides a discussion of regulatory requirements, standards, and guidance for the various COCs identified at the site. In Section 2.5, a recommended remediation goal for each COC is selected from the possible remediation goal options and has been assumed for purposes of evaluation of remedial alternatives in this FS. Section 2.6 describes areas of remediation for the FS under various remediation goal scenarios. Finally, remedial action objectives are developed based on remediation goals, regulatory requirements and guidance, current and potential future human health risks, and current and future land use considerations in Section 2.7.

2.1 Risk Assessment Summary

Potential receptors evaluated for Site 84 included current adolescent and adult recreational users, current Base personnel, future industrial/commercial workers, future adult and child residents, and future construction workers. Two distinct exposure scenarios were evaluated. The first exposure scenario included the soil around the perimeter of the Building 45 foundation that will be excavated during the non-time-critical removal action (NTCRA), which is scheduled to be conducted in the summer of 2002. The second exposure scenario excluded the soil that will be excavated during the NTCRA. As the NTCRA will be completed before remedial actions presented in this FS are implemented, this study is concerned with the second exposure scenario that excludes soil to be excavated during the NTCRA.

2.1.1 Soil

Soil remaining after the NTCRA does not contribute significantly to unacceptable carcinogenic risks or to unacceptable noncarcinogenic adverse health effects for the current receptors or for potential future industrial/commercial or construction workers. However, exposure to PCBs in surface soil remaining on site after the NTCRA does contribute to unacceptable carcinogenic risks for the potential future adult and child resident.

2.1.2 Groundwater

Arsenic in the shallow groundwater contributed to potentially unacceptable carcinogenic risk values for future child and adult residents and future industrial/commercial worker evaluated for exposure to groundwater. 2-Methyl-4-chlorophenoxyacetic Acid (MCPA), arsenic, iron, and thallium in the shallow groundwater also contributed to unacceptable total site HI values. However, the surficial aquifer is not used as a potable water supply and it is unlikely to be used in the future as a source for potable water.

Dermal exposure to groundwater contributed to slightly elevated noncarcinogenic adverse health effects for a potential future construction worker. Antimony, MCPA, iron, manganese, and thallium contributed to the construction worker dermal contact risk.

2.2 Land Use Considerations/Land Use Controls

Site 84 is located just south of Highway 24 at MCB, Camp Lejeune, one mile west of the main gate entrance (Figure 1-1). The site is fenced to prevent vehicular access from Highway 24. Vehicular access to the site is gained from the Base on the south side of the site or through the chain link fence along the highway. The northeast edge of the study area runs along railroad tracks and the northwest edge is bordered by Northeast Creek. The site extends to the south and east to encompass the foundation of Building 45 and a small lagoon. Building 45 was the location of a former electric substation, where transformers were known to be used and possibly stored. Toward the creek, the site is mostly wooded or covered by thick vegetation or grass. Wetland areas are present adjacent to the creek. An access road runs through the site and terminates at Northeast Creek. A map showing the various site features is presented as Figure 1-2.

Currently, the site is not used and vehicular access is restricted. Future land use for the site has not been definitively determined, therefore, remedial alternatives are developed that would allow for recreational land uses such as a marina or community park, high-occupancy land uses such as housing or offices, and low-occupancy land uses such as for an electrical substation or warehouse/equipment storage.

In the early 1940s, land was acquired to develop a railroad connection between the existing Seaboard Coastline Railroad and MCB, Camp Lejeune. Due to changing transportation needs, the railroad is no longer used, and the Base plans to transfer a portion of the railroad right-of-way from Route 17 to Route 24 to the City of Jacksonville for a pedestrian/bicycle trail. A portion of this trail will be developed along the northern border of Site 84. Therefore, fencing may be necessary to prevent recreational trespassers from accessing the site. Figure 1-2 shows the right of way designated for the rails-to-trails path. Additional sampling will take place during the remedial action phase at the northern portion of Site 84 between existing sampling locations with detected contaminants above screening criteria and the railroad tracks. This will further delineate the areas of contamination near the future rails-to-trails path.

Remedial alternatives that leave contaminants on the site above the selected cleanup goal may include land use controls. Land use controls may be implemented to manage future land use, to restrict site access, or to restrict certain types of activities at a site. Examples of land use controls include restrictions such as fencing, aquifer use restrictions, or deed restrictions that limit allowable land uses and/or place restrictions on certain intrusive activities (e.g., excavation) at the site. Land use controls can be used to control all or parts of the site.

2.3 Media of Concern/Contaminants of Concern

The results of the human health risk assessment for groundwater presented in the RI report indicate that the total carcinogenic and noncarcinogenic risks exceed the USEPA acceptable risk range for future receptors that may use groundwater in the surficial aquifer at Site 84 for potable water supply purposes. Iron, arsenic, and MCPA in groundwater were the main contributors to risk. Thus, contaminated groundwater is a media of concern for the FS. However, since groundwater has relatively minor levels of contaminants, is not currently used as a potable water supply, and is not likely to be used as a potable water supply in the future, active groundwater remediation is not appropriate for Site 84 and will not be evaluated in this FS. Instead, protection of human health will be achieved through aquifer use restrictions designed to prevent future use

of the aquifer at Site 84 for potable purposes. Remedial alternatives for groundwater presented in this FS include a no action alternative and a groundwater monitoring alternative.

The human health risk assessment indicates that soil remaining after the NTCRA does not contribute to unacceptable risks for the current receptors or for future industrial/commercial workers. However, exposure to PCBs in surface soil does contribute to unacceptable carcinogenic risks for the potential future adult and child resident and future construction worker. In addition, some contaminants in soil do exceed recommended cleanup levels based on regulatory requirements and guidance. Therefore, contaminated soil is a media of concern for the FS.

Detected concentrations of groundwater and soil contaminants will be compared to regulatory standards or remediation goals to be developed in Section 2.5 to generate a list of contaminants of concern (COCs) for this FS. Any contaminant that does not exceed its applicable regulatory standard or remediation goal will be eliminated from the list of COCs, thus eliminating it from further consideration in the FS. Contaminants that exceed the remediation goals are retained as final COCs. The final COCs will be the basis for defining areas of concern and evaluating remedial action alternatives.

2.4 Applicable or Relevant and Appropriate Requirements (ARARs)

Regulatory requirements, standards, and guidance are also referred to as "applicable or relevant and appropriate requirements" (ARARs) and "to be considered" (TBCs) requirements. ARARs and TBCs are defined and described in general in Section 2.4.1. Section 2.4.2 presents and describes specific ARARs and TBCs identified as applicable or appropriate to Site 84.

2.4.1 Definition of Applicable or Relevant and Appropriate Requirements (ARARs) and "To Be Considered" (TBC) Requirements

Under Section 121(d)(1) of CERCLA, remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Additionally, CERCLA remedial actions that leave any hazardous substances, pollutants, or contaminants on site must meet, upon completion of the remedial action, a level or standard of control that at least attains standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate" under the circumstances of the release. These requirements are known as "ARARs" or applicable or relevant and appropriate requirements. ARARs are derived from federal and state laws.

ARARs are categorized as one of three basic types: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs include requirements which set health or risk-based concentration limits or ranges for specific hazardous substances, pollutants, or contaminants. Federal MCLs established under the Safe Drinking Water Act (SDWA) are examples of chemical-specific ARARs.

Location-specific ARARs set restrictions on activities based upon the characteristics of the site. Examples include federal and state siting laws for hazardous waste facilities and sites on the National Register of Historic Places.

The third classification of ARARs, action-specific, refers to requirements that set controls or restrictions on particular activities related to the management of hazardous substances, pollutants, or contaminants. RCRA regulations for closure of hazardous waste storage units and pretreatment standards for discharges to publicly owned treatment works under the Clean Water Act (CWA) are examples of action-specific ARARs.

Subsection 121(d) of CERCLA requires that a remedial action meet a level or standard which at least attains federal and state substantive requirements that qualify as ARARs. Federal, state, or local permits are not necessary for removal or remedial actions to be implemented on site, but their substantive requirements or ARARs must be met. ARARs for a particular site depend on the detected contaminants, specific site characteristics, and particular remedial actions proposed for the site. Potential ARARs identified for Site 84 are presented in Section 2.4.2.

Advisories, criteria, or guidance documents that do not meet the definition of ARARs, but may be considered to determine what is protective or are useful in developing CERCLA remedies are referred to as "to-be-considered" (TBC) requirements. The ARARs preamble [40 CFR Part 300.400(g)(3)] describes three types of TBCs: health effects information with a high degree of credibility, technical information on how to perform or evaluate site investigations or remedial actions, and policy.

2.4.2 Potential ARARs and TBCs for Site 84

The chemical-specific, location-specific, and action-specific ARARs and TBCs that were identified for Site 84 are presented below.

2.4.2.1 Chemical-Specific ARARs and TBCs

Potential state and federal chemical-specific ARARs identified for Site 84 are summarized on Tables 2-1 and 2-1a, respectively. Primary chemical-specific ARARs and TBCs identified for the COCs in soil at Site 84 are listed below:

- Cleanup levels for PCBs under the Toxic Substances Control Act (TSCA)
- Disposal and storage requirements for PCBs under TSCA
- USEPA guidance on PCB cleanup levels
- USEPA Region IX Residential and Industrial Preliminary Remediation Goals (PRGs)
- North Carolina UST Program guidelines for TPH
- North Carolina Groundwater Standards

Brief descriptions of these chemical-specific ARARs/TBCs as they pertain to Site 84 are provided below.

Cleanup levels for PCBs under TSCA

The TSCA PCB Disposal Regulations (40 CFR Parts 750 and 761), final amendments issued June 29, 1998, are ARARs that address treatment, storage, and disposal requirements for PCB materials including remediation waste (e.g., PCB-contaminated soils/sediments). The TSCA regulations of importance to CERCLA remedial actions are found in 40 CFR 761.60 – 761.79, Subpart D: Storage and Disposal (USEPA, 1990). The disposal regulations provide specific cleanup standards for PCB remediation waste under both low-occupancy and high-occupancy land use scenarios, as described below.

High-occupancy areas are defined as areas where an unprotected individual would be present for more than 335 hours/year, or more than 6.7 hours/week on average. Examples of high-occupancy areas include a residence, school, office, or industrial workstation. The cleanup levels for PCBs in high-occupancy areas are:

- 1 ppm without additional controls, or
- 10 ppm if the area is capped with a soil, concrete, or asphalt cover

Low-occupancy areas are defined as areas where an unprotected individual would be present for less than 335 hours/year, or less than 6.7 hours/week on average. Examples of low-occupancy areas include an electrical substation or a non-office warehouse facility. The cleanup levels for PCBs in low-occupancy areas are:

- 25 ppm without additional controls, or
- 50 ppm if the site is secured with fencing and signs, or
- 100 ppm if the area is capped with a soil, concrete, or asphalt cover

Disposal and Storage Requirements for PCBs > 50 ppm under TSCA

The TSCA PCB Disposal Regulations also address disposal requirements for PCB remediation waste (e.g., PCB-contaminated soils/sediments). The disposal regulations specify that soils contaminated with PCBs at concentrations greater than or equal to 50 ppm may be disposed of by incineration, treated by an equivalent method (equal to incineration), or disposed in a chemical waste landfill meeting TSCA requirements as described in 40 CFR 761.75. In addition, the regulations specify that soils contaminated with PCBs at concentrations greater than or equal to 50 ppm must be disposed of within one year after being excavated and placed in storage. Specific storage facility requirements are also specified in the regulations.

It should be noted that soils contaminated with PCBs at concentrations less than 50 ppm may be disposed at a permitted solid waste disposal facility such as a municipal waste landfill.

USEPA Guidance for PCB Cleanup Levels

The EPA guidance document "Guidance on Remedial Actions for Superfund Sites with PCB Contamination" (USEPA, 1990) is not federal or state law and therefore is not an ARAR. However, it is federal guidance that addresses PCB contamination at CERCLA sites and therefore is considered "TBC" information for Site 84. This guidance provides the following recommended soil action levels as risk-based "starting points" for PCB-contaminated soil:

- Residential Land Use: 1 ppm
- Non-residential or Industrial Land Use: 10 to 25 ppm

These concentrations are risk-based levels that reflect an increased cancer risk in the acceptable range of 10^{-4} to 10^{-6} and are based on standard exposure assumptions, which may be "overly conservative on a site-specific basis" (USEPA, 1990). These action levels indicate PCB levels that can be left on site without management controls.

USEPA Region IX PRGs

Preliminary Remediation Goals (PRGs) are human health, risk-based concentrations developed to predict single-contaminant risk estimates for a specific environmental media. Human health risk estimates are used in conjunction with ARARs and/or other factors when ARARs are not available for developing cleanup goals. PRGs are derived from standardized equations, combining exposure information, assumptions, and EPA toxicity data. PRGs are concentrations that correspond to either a one in a million (10^{-6}) cancer risk or a "safe" Reference Dose (RfD), whichever is lower. Therefore, PRGs are concentrations of constitutents in environmental media that are protective of human health and the environment. However, environmental levels that exceed PRGs will not necessarily produce adverse health effects.

The USEPA Region IX PRGs should be viewed as guidelines, not legally enforceable cleanup or remediation standards. PRGs are not de facto cleanup standards and generally should not be applied as such. However, they are helpful in providing a point of departure toward remediation targets to use during the analysis of different remedial alternatives. PRGs are not ARARs; however, they are federal guidance and therefore are considered "TBC" information for Site 84. Due to proposed future land use considerations for Site 84, USEPA Region IX Residential and Industrial PRGs will be used for site "screening" and will be evaluated as initial remedial goals for VOCs, SVOCs, and metals in site soil and lagoon sediments.

North Carolina UST Program for TPH

North Carolina UST Program requirements (Subchapter 2L, Section .0115) are not directly applicable since the TPH contamination being addressed in this FS is not under the UST Program (the petroleum contamination near the former Building 45 is being addressed by an on-going air sparging/SVE system under the UST Program). Nonetheless, they are relevant and appropriate requirements for TPH contamination at Site 84. North Carolina currently refers to total petroleum hydrocarbons (TPH) in terms of volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH). However, data for this site is provided in terms of

TPH and the North Carolina UST Regulations also refer to TPH; therefore, the term TPH is used in this FS.

The North Carolina UST regulations provide two options for cleanup of TPH-contaminated soil, a general guideline that can be applied to any site and a site-specific approach. The general guideline approach provides specific cleanup standards for TPH as follows:

Low-boiling point fuels (e.g., gasoline)	10 ppm TPH
High boiling point fuels (e.g., diesel, kerosene)	40 ppm TPH
Waste oil and heavy fuels (e.g., motor oil, hydraulic fluid)	250 ppm TPH

North Carolina Groundwater Standards

The North Carolina Groundwater Standards (Subchapter 2L) establish allowable levels of organic and inorganic constituents in groundwater and are applicable to Site 84. These groundwater standards, in addition to available information regarding Base background concentrations, will be used as screening criteria to determine contaminants of concern for groundwater.

2.4.2.2 Location-Specific ARARs

Potential state and federal location-specific ARARs identified for Site 84 are summarized on Tables 2-2 and 2-2a, respectively. Based on a review of these ARARs, specific sections of the following location-specific ARARs may be applicable to Site 84:

- North Carolina Coastal Management
- Fish and Wildlife Coordination Act
- Federal and North Carolina Endangered Species Acts
- Executive Order 11990 on Protection of Wetlands
- Executive Order 11988 on Floodplain Management

Note that the citations listed on Tables 2-2 and 2-2a should not be interpreted to indicate that the entire citation is an ARAR. The citation listing is provided on the table as a general reference.

2.4.2.3 Action-Specific ARARs

Action-specific ARARs are typically evaluated during the development and detailed evaluation of alternatives since they are dependent on the type of action being considered. Nonetheless, potential state and federal action-specific ARARs identified for Site 84 are summarized on Tables 2-3 and 2-3a, respectively. These ARARs are based on RCRA, TSCA, CWA, SDWA, and Department of Transportation (DOT) requirements.

Note that the citations listed on Table 2-3 and 2-3a should not be interpreted to indicate that the entire citation is an ARAR. The citation listing is provided on the table as a general reference.

2.5 Remediation Goals and Final COCs

Remediation goals may be established based on regulatory requirements, standards, and guidance, or, site-specific, risk-based remediation goals can be developed based on future land use considerations and other site-specific information. The remediation goals for Site 84 COCs were selected based on a combination of regulatory requirements, standards, and guidance, as well as site-specific, risk-based remediation goals based on future land use considerations for Site 84. A recommended remediation goal is chosen for each COC to be used in the development of remedial alternatives in the FS.

Selected soil remediation goals for high-occupancy land use, low-occupancy land use, and recreational land use for Site 84 and the basis for each remedial goal are provided below in Sections 2.5.1, 2.5.2, and 2.5.3, respectively. Final soil COCs are summarized in Section 2.5.4.

Since groundwater has relatively minor levels of contaminants, is not currently used as a potable water supply, and is not likely to be used as a potable water supply in the future, active groundwater remediation is not appropriate for Site 84 and will not be evaluated in this FS. Groundwater data will be compared to state and federal regulatory standards to identify groundwater COCs and remediation goals.

2.5.1 Soil Remediation Goals for High-Occupancy Land Use

The selected soil remediation goal for PCBs for high-occupancy land use without additional controls is 1.0 ppm, based on TSCA regulations, which call for a 1.0 ppm remediation goal for

PCBs in high-occupancy areas with no additional engineering or land use controls. This remediation goal is also consistent with USEPA guidance for residential land use (USEPA, 1990). In accordance with TSCA, a PCB remediation goal of 10 ppm is selected for high-occupancy areas under a capping alternative.

For a high-occupancy land use scenario, soil remediation goals for PAHs/pesticides are the EPA Region IX Residential PRGs. Soil remediation goals of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program. In summary, the remedial goals for high-occupancy land use are:

- PCBs 1.0 ppm (without additional controls)
- PCBs 10 ppm (with capping)
- PAHs/pesticides EPA Region IX Residential PRGs
- TPH (GRO) 10 ppm
- TPH (DRO) 40 ppm

2.5.2 Soil Remediation Goals for Low-Occupancy Land Use

The selected soil remediation goal for PCBs for low-occupancy land use without additional controls is 10 ppm based on USEPA guidance (USEPA, 1990), and is 25 ppm based on TSCA regulations, which call for a 25 ppm remediation goal for PCBs in low-occupancy areas with no additional engineering or land use controls. This range of values is also consistent with USEPA guidance, which calls for 10 – 25 ppm cleanup goal for non-residential or industrial land use (USEPA, 1990). The selected remediation goal for PCBs for low-occupancy land use with fencing is 50 ppm, based on TSCA requirements that specify a cleanup level of 50 ppm for a low-occupancy area when the site is secured with fencing and signs. In accordance with TSCA, a PCB remediation goal of 100 ppm is selected for low-occupancy land use under a capping alternative.

For a low-occupancy land use scenario, soil remediation goals for PAHs/pesticides are the EPA Region IX Industrial PRGs. Soil remediation goals of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program. In summary, the remedial goals for low-occupancy land use are:

- PCBs (EPA) 10 ppm (industrial land use recommendation)
- PCBs (TSCA) 25 ppm (without additional controls)
- PCBs (TSCA) 50 ppm (with site fencing)
- PCBs (TSCA) 100 ppm (with capping)
- PAHs/pesticides EPA Region IX Industrial PRGs
- TPH (GRO) 10 ppm
- TPH (DRO) 40 ppm

2.5.3 Soil Remediation Goals for Recreational Land Use

The soil remediation goals for recreational land use are risk-based values, developed to be protective of recreational users at Site 84. Risk-based remediation goals for recreational land use were selected for the adult recreational user based on an incremental cancer risk (ICR) of 1×10^{-5}, which is within EPA's acceptable risk range. Risk-based remediation goals were developed for those constituents that were determined to be final COCs for a high-occupancy land use (see section 2.5.4). The risk-based soil remediation goal developed for PCBs is 7.7 ppm without additional controls. For PAHs/pesticides, risk-based soil remediation goals were developed for selected constituents based on a recreational land use. Remediation goals for TPH of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program. In summary, the remedial goals for recreational land use are:

- PCBs 7.7 ppm (without additional controls)
- PAHs/pesticides risk-based goals for recreational land use (see Table 2-14)
- TPH (GRO) 10 ppm
- TPH (DRO) 40 ppm

2.5.4 Final Contaminants of Concern (COCs)

Contaminants present at Site 84 in exceedance of their remediation goals are COCs for this FS. For each contaminant, maximum detected concentrations (post-NTCRA) in surface soil, subsurface soil, and lagoon sediments were compared to remediation goals for low-occupancy and high-occupancy land use. For recreational land use, risk-based remediation goals were developed and COCs were assumed to be the same as for high-occupancy land use.

Comparisons of contaminants to remediation goals for high-occupancy land use are presented in Tables 2-4, 2-5, and 2-6 for surface soil, subsurface soil, and lagoon sediments, respectively. The list of final COCs and their respective remediation goals for high-occupancy land use are summarized in Table 2-7.

Comparisons of contaminants to remediation goals for low-occupancy land use are presented in Tables 2-8, 2-9, and 2-10 for surface soil, subsurface soil, and lagoon sediments, respectively. The list of final COCs and their respective remediation goals for low-occupancy land use are summarized in Table 2-11.

Tables 2-12 and 2-13 present exposure parameters and assumptions used to derive risk-based remediation goals for adult and adolescent recreational users, respectively. Remediation goals selected for Site 84 are for the adult recreational user, which are more conservative than for the adolescent recreational user. The selected remediation goals are for a 1×10^{-5} incremental cancer risk (ICR). Remediation goals and final COCs for recreational land use are summarized in Table 2-14.

Comparison of contaminants to remediation goals for groundwater is presented in Table 2-15. The list of final COCs and their respective remediation goals are summarized in Table 2-16.

2.6 Areas of Remediation

Surface soil, subsurface soil, and sediment have been identified as the only media of concern for active remediation in this FS. Groundwater is a medium of concern, but will not be actively remediated, therefore, an area of remediation will not be identified/delineated. The areas of remediation for soil represent the areas of excavation for a soil removal alternative or the area to be covered under a capping alternative. Specific areas of remediation for soil are defined as areas where contaminant concentrations exceed remedial goals as defined in Section 2.5 for low-occupancy, high-occupancy, or recreational land use.

The areas of remediation for the various types of contaminants, as defined by exceedances of remediation goals, are illustrated on the following figures:

- Figure 2-1 Exceedances of Total Petroleum Hydrocarbons (TPH) in Soil
- Figure 2-2 Exceedances of Residential PRGs in Soil
- Figure 2-3 Exceedances of Industrial PRGs in Soil
- Figure 2-4 Exceedances of PCBs (1 ppm) in Soil
- Figure 2-5 Exceedances of PCBs (10 ppm) in Soil
- Figure 2-6 Exceedances of PCBS (25 ppm) in Soil
- Figure 2-7 Exceedances of PCBs (50 ppm) in Soil
- Figure 2-8 Exceedances of PCBs (100 ppm) in Soil
- Figure 2-9 Exceedances of Recreational Remedial Goals in Soil

These areas of remediation will be used as a basis to estimate volumes of contaminated soil for each remedial action alternative in Section 4.0. For purposes of this FS, the estimated soil quantities will exclude the former Building 45 area, which will be addressed by the proposed NTCRA. It is unknown whether or not additional removal of soils will be required in this area until confirmatory sampling results from the NTCRA are reviewed.

2.7 Remedial Action Objectives

Remedial action objectives are medium-specific or site-specific goals established for protecting human health and the environment. At Site 84, the environmental media to be addressed by remedial actions include groundwater, contaminated soil in certain areas of the site, and sediment in the lagoon area. Remedial action objectives for Site 84 are:

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *high-occupancy land use* (e.g., residence, school, or office), OR

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *low-occupancy land use* (storage area, non-office warehouse, or electrical substation), OR

- Remove or mitigate potential exposure to contaminated surface and subsurface soils on the site that contain contaminants in excess of the selected remediation goals (cleanup levels) for *recreational land use* (e.g., marina, fishing, boating, swimming).

- Protect human health by mitigating the potential for exposure to the contaminated surficial aquifer.

- Backfill the lagoon, which is considered a potential physical hazard at the site.

3.0 IDENTIFICATION AND PRELIMINARY SCREENING OF REMEDIAL ACTION TECHNOLOGIES

Section 3.0 presents the identification and preliminary screening of remedial action technology types and process options that may be applicable to the remediation of soil at Site 84. More specifically, Section 3.1 identifies a set of general response actions, Section 3.2 identifies remedial action technology types and process options for each general response action, and Section 3.3 presents the preliminary screening of the remedial action technology types and process options. After the preliminary screening, the remaining technology types/process options undergo a process option evaluation in Section 3.4. The final set of remedial action technology types and a brief description of the options that pass the process option evaluation is presented in Section 3.5.

Soil is the only medium of concern for purposes of screening remedial action technologies for this FS. Groundwater is a medium of concern in this FS, but will not be actively remediated, therefore, groundwater remedial technologies will not be identified/evaluated.

3.1 General Response Actions

General response actions are broad-based, medium-specific categories of actions that can be identified to satisfy the remedial action objectives of an FS. Due to the nature of soil contamination at Site 84, five general response actions have been identified for these sites. The general response actions include: no action, institutional controls, containment/removal actions, and in-situ and ex-situ treatment actions. A brief description of these general response actions follows.

3.1.1 No Action

The NCP requires the evaluation of the no action response as part of the FS process. A no action response provides a baseline assessment for comparisons involving other remedial alternatives that offer a greater level of response. A no action alternative may be considered appropriate when there are no adverse or unacceptable risks to human health or the environment, or when a response action may cause a greater environmental or health danger than the no action alternative.

3.1.2 Institutional Controls

Institutional controls are various "institutional" actions that can be implemented at a site to minimize exposure to potential hazards at the site. These controls are typically considered to be "passive" actions such as limiting exposure to contaminated soil by access restrictions (e.g., fencing) or by placing restrictions on the allowable land uses of a contaminated area.

3.1.3 Containment/Removal Actions

This general response action combines both containment and removal actions. Containment actions include technologies that contain and/or isolate contaminants by covering, sealing, or providing an effective barrier over or around specific areas of concern. These actions also provide isolation and prevent direct exposure with or migration of the contaminated media.

Excavation is a method for removing contaminated soil using conventional heavy construction equipment such as backhoes, cranes, bulldozers and loaders. With respect to Site 84, the soil and sediments could be excavated and then treated (on site or off site) or sent off site for disposal.

3.1.4 Treatment Actions

A typical general response action applicable to soil remediation involves a combination of removal, treatment, and/or disposal actions. Treatment actions (in-situ and ex-situ) for soil can include biological, physical/chemical, and thermal treatment methods. In-situ treatments may result in production of process water or products from off-gas treatment systems. Ex-situ treatments may result in process water, products from off-gas treatment systems and/or contaminated soil. These remediation end products may need to be further treated or disposed. Treatment may include one of a number of on-site or off-site treatment actions. Disposal may include on-site or off-site landfill options in addition to recycling options.

3.2 Identification of Remedial Action Technologies and Process Options

In this step, a set of potentially applicable technologies and process options will be identified for each of the general response actions listed in the previous section. The term, "technology type" refers to general categories of technologies such as physical/chemical, thermal, and biological. The term "process option" refers to specific processes, or technologies, within each generalized

technology type. For example, soil washing and solvent extraction are process options under the technology type known as physical/chemical treatment. Several technology types may be identified for each general response action, and numerous process options may exist within each generalized technology type.

With respect to their corresponding general response actions, the remedial action technology types and the associated process options that are potentially applicable at Site 84 are identified on Table 3-1.

3.3 Preliminary Screening of Remedial Action Technologies and Process Options

During the preliminary screening, the set of remedial action technology types and process options identified on Table 3-1 have been screened (or reduced) by evaluating the technology types with respect to contaminant-specific and site-specific factors. This screening step was accomplished by using available information from previous site investigations (i.e., information regarding contaminant types, contaminant concentrations, and site characteristics) to screen out technology types and process options that cannot be effectively implemented at the site (USEPA, 1988). In general, all technology types and process options that appear to be applicable to the site contaminants and site conditions have been retained for further evaluation. The preliminary screening for Site 84 is presented on Table 3-2.

As noted on Table 3-2, several technology types and/or process options were eliminated from further evaluation because they were determined to be inappropriate based on site-specific characteristics and/or contaminant-specific characteristics that were identified for Site 84.

3.4 Process Option Evaluation

The objective of the process option evaluation is to select only one representative process option for each applicable remedial technology type to simplify the subsequent development and evaluation of remedial alternatives. In some cases, more than one process option may be selected for a technology type if the processes are sufficiently different in their performance. It is important to note that the elimination of a process option does not mean that the process option can never be reconsidered for the site. The representative process option simply provides a basis for remedial alternative evaluation during the FS. However, the specific process option used to implement the remedial action may not be selected until the remedial design phase.

During the process option evaluation, the process options retained on Table 3-2 were further evaluated based on three criteria: effectiveness, implementability, and relative cost. The evaluation of effectiveness focused on: the potential effectiveness of a process option in meeting the remedial action objectives; the potential impacts to human health and the environment during the construction and implementation phase; and how reliable the process is with respect to the COCs. The evaluation of implementability focused on the administrative feasibility of implementing a technology (e.g., obtaining permits), since the technical implementability was previously considered in the preliminary screening. The evaluation of relative cost played a limited role in this screening. Only relative capital and operating and maintenance (O&M) costs were used instead of detailed estimates. As per USEPA guidance (USEPA, 1988), the relative cost analysis was made on the basis of engineering judgement. A summary of the process option evaluation is presented on Table 3-3.

3.5 Final Set of Remedial Action Technologies/Process Options

Table 3-4 identifies the final set of feasible technology types and process options that were used to develop remedial action alternatives for Site 84. A brief description of each technology type/process option from the final set is presented below.

3.5.1 No Action

The no action alternative will be considered at Site 84. The no action response provides a baseline for comparison with other response actions and is required to be evaluated by the NCP. Under the no action response, the contaminated media at each site will be left in place. Passive remediation of organic contaminants (i.e., natural attenuation) may occur, but will be unmonitored. No active institutional controls or active remediation efforts would be implemented at a site if the no action alternative were selected.

3.5.2 Site Access Restrictions

The site access restrictions process option includes the installation and/or maintenance of new security fencing and signs around the contaminated media at Site 84, including fencing along the site's border with Highway 24. Warning signs would be posted along the fence. The fencing option would minimize direct exposure to the impacted soil at the site by reducing the potential for dermal contact with or ingestion of the soil.

3.5.3 Land Use Restrictions

Land use controls are implemented to manage future land use or to restrict certain types of activities at a site. Examples of land use controls include aquifer use restrictions or deed restrictions that limit allowable land uses and/or place restrictions on certain intrusive activities (e.g., excavation, installation of wells, or construction) at the site. Land use controls can be used to control all or parts of the site. Remedial alternatives that leave soil on the site above the selected cleanup goal may include land use controls that either restrict future allowable land uses and/or restrict certain excavation/construction activities. This process option eliminates exposure to the contaminated soil by restricting future exposure at the site.

3.5.4 Capping

A capping process option (i.e., soil cover) for Site 84 would consist of placing compacted soil fill, with topsoil and vegetation on top of the compacted fill. The soil cover would reduce the potential for direct exposure to the contaminated soil and would minimize the potential for contaminant migration via surface water runoff and erosion. However, as contaminants do remain in the soil, permanent erosion controls are required as well as aquifer use, land use and excavation restrictions.

For this process option, all soils exceeding cleanup criteria would be capped with a soil cover. Wooded and wetlands areas would need to be cleared and grubbed before capping.

3.5.5 Excavation and Landfill Disposal

The excavation process option involves the removal of contaminated soil from the site to a location where human and ecological exposure pathways are significantly reduced. Post-excavation confirmatory sampling will be conducted to ensure the removal of PCBs, PAHs and TPH to the appropriate final cleanup levels and to ensure a complete removal action. TSCA-regulated soils (PCBs greater than 50 ppm) will be separated and transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. It is anticipated that non-TSCA-regulated soils will be disposed at the Base landfill.

4.0 DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES

In this phase of the FS, process options and remedial action technologies are combined to form potential response action alternatives (RAAs) for Site 84. The development process for soil RAAs and a description of each soil RAA are presented in Section 4.1. Groundwater RAAs are developed and presented in Section 4.2.

4.1 Development of Soil Remedial Action Alternatives

Soil RAAs were developed by combining the remedial action technologies and process options selected for Site 84 in Section 3.0. Eight RAAs (plus "options" for three of the RAAs) were developed to address soil contamination detected at Site 84. These include the no action RAA, two high-occupancy (unrestricted) land use RAAs, four low-occupancy land use RAAs, and one recreational land use RAA.

The high-occupancy land use RAAs would allow for future land uses such as housing, schools, parks, marinas, and/or office building uses. The low-occupancy land use RAAs would allow for future land uses such as non-office warehouses, equipment storage facilities, and/or electrical substations. The recreational land use RAA would be protective for future land uses such as marinas, boating, fishing, and community parks.

The soil RAAs represent a wide range of response actions, remediation goals, potential land uses, land use controls, and remediation costs. A summary table that presents a description, allowable land uses, land use controls required, and remediation goals for each soil RAA is provided as Table 4-1. The RAAs are listed below and the subsections that follow describe each RAA.

- RAA 1: No Action
- RAA 2: Excavation and Landfill Disposal (High-Occupancy Land Use, No Access Restrictions)
- RAA 2a: Excavation and Landfill Disposal (High-Occupancy Land Use, Access Restrictions)

- RAA 3: Excavation and Capping (High-Occupancy Land Use, No Access Restrictions)
- RAA 3a: Excavation and Capping (High-Occupancy Land Use, Access Restrictions)
- RAA 4: Excavation and Landfill Disposal (Low-Occupancy Land Use)
- RAA 5: Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)
- RAA 6: Hot Spot Removal and Fencing (Low-Occupancy Land Use)
- RAA 7: Hot Spot Removal and Capping (Low-Occupancy Land Use)
- RAA 8: Excavation and Landfill Disposal (Recreational Land Use, No Access Restrictions)
- RAA 8a: Excavation and Landfill Disposal (Recreational Land Use, Access Restrictions)

The high-occupancy and recreational land use RAAs will include two scenarios. The first scenario is a "no access restrictions" scenario and involves removal or capping of all soil on the site that contains contaminants in exceedance of the remedial goals. The second scenario is an "access restrictions" scenario that involves removal or capping of contaminated soil within the open areas of the site, and includes fencing to restrict access to the wetland/wooded area in the northwest corner of the site such that this wetland/wooded area does not have to be destroyed by excavation or capping remedial actions. The goals of this second scenario are to reduce remediation costs, preserve wetlands and wildlife habitats, and improve site aesthetics.

4.1.1 RAA 1: No Action

Under the no action RAA, no physical remedial actions will be performed to reduce the toxicity, mobility, or volume of contaminants identified in soil at Site 84. In addition, no land use controls or land use restrictions will be implemented at the site. Vehicular access by the general public is currently partially restricted by existing fencing along the highway. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response.

Although this RAA does not involve physical remediation, some degree of remediation of the soil contamination is expected to occur over time via natural attenuation processes including naturally occurring biodegradation, volatilization, dilution, leaching, adsorption, and chemical reactions between subsurface materials. However, the soil contaminants at Site 84, such as PCBs and PAHs, are known for their environmental persistence, therefore, these natural attenuation processes are expected to require a very long period of time. Under the No Action RAA, however, no means are provided to monitor or confirm the natural remediation process.

Since contaminants will remain at Site 84 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

4.1.2 RAA 2: Excavation and Landfill Disposal (High-Occupancy Land Use, No Access Restrictions) and RAA 2a: Excavation and Landfill Disposal (High-Occupancy Land Use, Access Restrictions)

RAA 2 is recommended for high-occupancy future land uses such as housing, schools, parks, or office locations. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for high-occupancy land use. Remediation goals for this RAA include North Carolina UST Program cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), TSCA cleanup goals for PCBs for high-occupancy areas without additional controls (1.0 ppm), and EPA Region IX Residential PRGs for other contaminants (see Table 2-7).

This RAA has two options, a "no access restrictions" option and an "access restrictions" option. Under the "no access restrictions" option, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. The excavation area for this option can be seen in Figure 4-1 and the total volume for site-wide excavation is approximately 7,600 cubic yards (CY). Under the "no access restrictions" option, impacted wetland and wooded areas, that are costly to clear and excavate, would be included in the excavation process. As the contaminated soil in the wetland/wooded areas is shallow and much of it is adhered to plant roots, removal of this soil would require either root washing or off-site disposal of roots and soil together. For the FS, it is assumed that both soils and plant roots would be disposed together. In order to dewater the wetland/wooded area soils prior to landfill disposal, these wet soils will be excavated first and placed/spread on top of the contaminated soil in the open areas of the site and allowed to naturally dewater. Prior to excavation, the contamination in the wetland areas would need to be further delineated to ensure that only contaminated areas of the wetland would be disturbed. As

excavation of the wetland area would destroy the wetland, this RAA option would require wetland restoration under the Clean Water Act.

An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site, shown in Figure 4-2 to restrict access to this area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The excavation volume under this option would be reduced to 5,700 CY. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on that portion of the site. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

In both options, confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for PCBs, PAHs, pesticides, and TPH. Excavated soils would be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be handled separately and would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions. Site restoration activities would include wetland restoration under the "no access restrictions" option.

Under the "no access restrictions" option, no land use controls would be necessary. Under the "access restrictions" option, land use controls would also include permanent access restrictions to the fenced wooded/wetland area and this area would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless

wetland mitigation was implemented. Intrusive restrictions are not necessary because remediation goals selected for protection of the residential receptor are also protective of the future construction worker. In both options, a fence will be installed parallel to the railroad tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

4.1.3 RAA 3: Excavation and Capping (High-Occupancy Land Use, No Access Restrictions) and RAA 3a: Excavation and Capping (High-Occupancy Land Use, Access Restrictions)

RAA 3 is recommended for high-occupancy future land uses such as housing, schools, parks, or office locations. This RAA will include the excavation of contaminated soils that exceed TSCA PCB cleanup goals for high-occupancy areas with capping (10 ppm) and installation of a soil cover over contaminated soils that exceed remediation goals for high-occupancy land use. Remediation goals for high-occupancy land use include North Carolina UST regulations cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), TSCA cleanup goals for PCBs for high-occupancy areas without additional controls (1.0 ppm), and EPA Region IX Residential PRGs for other contaminants (see Table 2-7).

Similar to RAA 2, this RAA has two options, a "no access restrictions" option and an "access restrictions" option. Under the "no access restrictions" option, all soil exceeding high-occupancy land use cleanup criteria would be capped, while only soil and lagoon sediments containing >10 ppm PCBs would be excavated and removed. Therefore, this RAA requires less excavation than RAA 2. Confirmatory sampling will take place to ensure that all contaminants exceeding 10 ppm for PCBs have been excavated. The capping and excavation areas for this option can be seen in Figure 4-3. The estimated excavation volume under the "no access restrictions" option is 3,200 CY. Under this option, impacted wetland and wooded areas, that are costly to clear and excavate, would be included in the capping or excavation process. Prior to excavation, the contamination in the wetland areas would need to be further delineated to ensure that only contaminated areas of the wetlands would be disturbed. In order to dewater the wetland/wooded area soils prior to landfill disposal, these wet soils will be excavated first and placed/spread on top of the contaminated soil in the open areas of the site and allowed to naturally dewater. As excavation of the wetland area would destroy the wetland, this RAA option would require wetland restoration under the Clean Water Act.

An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site, shown in Figure 4-4 to restrict access to this area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The excavation volume under this option would be reduced to approximately 2,700 CY. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on that portion of the site. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

The areas at Site 84 to be capped with a soil cover for a future high-occupancy land use for the "no access restrictions" and "access restrictions" scenarios are shown on Figures 4-3 and 4-4, respectively. The total area to be capped is approximately 3.9 acres under a "no access restrictions" scenario and approximately 3.2 acres under an "access restrictions" scenario. The soil cover will consist of 12 inches of clean backfill and six inches of topsoil. A soil cap will mitigate dermal exposure and will control erosion and migration of contaminated soil. However a soil cap will not minimize surface water infiltration and therefore does not protect the groundwater. The cap will be contoured so as to control erosion and sedimentation, and will be compacted and vegetated with native grasses and plant species. It is assumed that clean backfill can be obtained from an on-Base borrow source and that topsoil will be purchased from an off-site source. The cap will be inspected on an annual basis and after major storm events to ensure that integrity is maintained. Cap restoration will be performed, as needed, based upon inspection results. For costing purposes, it is assumed that inspections and maintenance (assuming that 10 percent of the cap area will require repairs) will be conducted annually.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade prior to capping. Following placement of the soil cap, all disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions. Site restoration activities would include wetland restoration under the "no access restrictions" option.

Because contaminated soil that poses a potential human health risk will remain at the site, land use controls will be required for this alternative. Land use controls will include restrictions on

intrusive activities at the site (e.g., excavation, installation of wells, or construction) other than for monitoring or future remediation purposes. In addition, under the "access restrictions" option, land use controls would also include permanent access restrictions to the fenced wooded/wetland area and this area would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented. In both options, a fence will be installed parallel to the railroad tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

4.1.4 RAA 4: Excavation and Landfill Disposal (Low-Occupancy Land Use)

RAA 4 is recommended for low-occupancy future land uses such as a non-office warehouse, equipment storage facility, or an electrical substation. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use. Remediation goals for this RAA include North Carolina UST cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), EPA cleanup goals for PCBs for industrial areas (10 ppm), and EPA Region IX Industrial PRGs for other contaminants (see Table 2-11).

Under this RAA, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. The excavation area for this option can be seen in Figure 4-5 and the total volume for site-wide excavation is approximately 3,650 cubic yards (CY).

Confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for PCBs, PAHs, pesticides, and TPH. Excavated soils would be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be handled separately and would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions.

Under RAA 4, institutional controls would also include permanent land use controls because contaminants exceeding high-occupancy and recreational remediation goals would remain on the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted. The entire site perimeter would be fenced to prevent recreational trespassers from accessing the site. This will be necessary since contaminants above recreational remedial goals would remain on site.

4.1.5 RAA 5: Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)

RAA 5 is recommended for low-occupancy future land uses such as a non-office warehouse, equipment storage facility, or an electrical substation. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use with no additional controls. Remediation goals for this RAA include North Carolina UST regulations cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), TSCA cleanup goals for PCBs for low-occupancy areas without additional controls (25 ppm), and EPA Region IX Industrial PRGs for other contaminants (see Table 2-11).

Figure 4-6 designates "hot spots" that exceed these low-occupancy remedial goals and will need to be excavated. The estimated volume of soil to be removed is approximately 3,100 CY. Removed contaminated soils will be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be separated and transported to a TSCA permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions.

Because contaminated soil poses a potential human health risk and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-

occupancy uses. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted. A fence will be installed along the entire site perimeter to protect recreational trespassers from contamination above recreational cleanup goals.

4.1.6 RAA 6: Hot Spot Removal and Fencing (Low-Occupancy Land Use)

RAA 6 is recommended for low-occupancy future land uses such as a non-office warehouse, equipment storage facility, or an electrical substation. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for low-occupancy land use with site fencing. Remediation goals for this RAA include North Carolina UST regulations cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), TSCA cleanup goals for PCBs for low-occupancy areas with fencing (50 ppm), and EPA Region IX Industrial PRGs for other contaminants (see Table 2-11).

Figure 4-7 designates "hot spots" that exceed these low-occupancy remediation goals and will need to be excavated. The estimated volume of soil to be removed is approximately 900 CY. Removed contaminated soils will be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be separated and transported to a TSCA permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions.

Site access restrictions to include fencing and posted signs will reduce exposure pathways by blocking access to the site and informing individuals of the site boundaries. A fence will be constructed and signs posted along the entire site perimeter. Figure 4-7 designates the area to be fenced.

Because contaminated soil poses a potential human health risk, and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-

occupancy uses. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted. The required fencing for this alternative will also protect potential recreational trespassers.

4.1.7 RAA 7: Hot Spot Removal and Capping (Low-Occupancy Land Use)

RAA 7 is recommended for low-occupancy future land uses such as a non-office warehouse, equipment storage facility, or an electrical substation. This RAA will include the installation of a soil cover over the contaminated soils that exceed remediation goals for low-occupancy land use with capping. Remediation goals for this RAA include North Carolina UST regulations cleanup goals for TPH (10 ppm GRO and 40 ppm DRO), TSCA cleanup goals for PCBs for low-occupancy areas with capping (100 ppm), and EPA Region IX Industrial PRGs for other contaminants (see Table 2-11).

Figure 4-8 shows the area at Site 84 to be capped with a soil cover for a future low-occupancy land use. The total area to be capped is approximately 1.4 acres. The soil cover will consist of 12 inches of clean backfill and six inches of topsoil, and will be contoured so as to control erosion and sedimentation, and will be compacted and vegetated with native grasses and plant species. It is assumed that clean backfill can be obtained from an on-Base borrow pit and that topsoil will be purchased from an off-site source. The cap will be inspected on an annual basis and after major storm events to ensure that integrity is maintained. Cap restoration will be performed, as needed, based upon inspection results. For costing purposes, it is assumed that inspections and maintenance will be conducted annually.

Soils with PCB concentrations above 100 ppm must be excavated as they exceed the TSCA cleanup level for low-occupancy land use with a cap. Figure 4-8 designates "hot spots" that exceed 100 ppm PCBs and will need to be excavated. During excavation, field screening will be conducted to ensure that all soils exceeding 100 ppm PCBs are removed. Removed contaminated soils will be classified as TSCA-regulated soils (PCBs greater than 50 ppm) and will be transported to a TSCA permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for off-site disposal. The estimated volume of soil to be removed is 30 CY.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed

areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions.

Because contaminated soil poses a potential human health risk, and will remain at the site, land use restrictions will be required for this alternative. Future land use will be restricted to low-occupancy uses. In addition, certain types of activities at the site, such as intrusive activities (e.g., excavation, installation of wells, or construction, other than for monitoring or future remediation purposes), will be restricted. The entire site perimeter will be fenced to prevent recreational trespassers from exposure to contaminated soils.

4.1.8 RAA 8: Excavation and Landfill Disposal (Recreational Land Use, No Access Restrictions) and RAA 8a: Excavation and Landfill Disposal (Recreational Land Use, Access Restrictions)

RAA 8 is recommended for recreational future land uses such as a marina, boating, fishing, or a community park. This RAA includes excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for recreational land use. The soil remediation goals for recreational land use are risk-based values, developed to be protective of recreational users at Site 84 (see Table 2-14). The risk-based remediation goal for PCBs at Site 84 is 7.7 ppm. Remediation goals for TPH of 10 ppm for TPH (GRO) and 40 ppm for TPH (DRO) were selected as stipulated by the North Carolina UST Program.

This RAA has two options, a "no access restrictions" option and an "access restrictions" option. Under the "no access restrictions" option, all soil and lagoon sediments exceeding cleanup criteria would be excavated and removed. The excavation area for this option can be seen in Figure 4-9 and the total volume for site-wide excavation is approximately 7,200 cubic yards (CY). Under the "no access restrictions" option, impacted wetland and wooded areas, that are costly to clear and excavate, would be included in the excavation process. In order to dewater the wetland/wooded area soils prior to landfill disposal, these wet soils will be excavated first and placed/spread on top of the contaminated soil in the open areas of the site and allowed to naturally dewater. Prior to excavation, the contamination in the wetland areas would need to be further delineated to ensure that only contaminated areas of the wetland would be disturbed. As excavation of the wetland area would destroy the wetland, this RAA option would require wetland restoration under the Clean Water Act.

An "access restrictions" option is added to this alternative to reduce costs, preserve wetlands and wildlife habitats, and improve site aesthetics. This is accomplished by adding fencing in the upper northwest corner of the site, shown in Figure 4-10 to restrict access to this area. Soils located within this fenced portion of the site that exceed remediation goals would remain without any further action. The excavation volume under this option would be reduced to 5,500 CY. The wetlands and thick wooded area in this portion of the site would remain intact, and site access restrictions and institutional controls would be implemented for the fenced area since contamination would remain on that portion of the site. This is a viable option since it is unlikely that the heavily wooded or wetlands area would be developed anyway, the natural habitat of many native animals would remain intact, and high costs for clearing and excavating the area would not be incurred.

In both options, confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for PCBs, PAHs, pesticides, and TPH. Excavated soils would be separated into TSCA-regulated and non-TSCA-regulated soils. TSCA-regulated soils (PCBs greater than 50 ppm) will be handled separately and would be transported to a TSCA-permitted chemical waste landfill meeting the requirements of 40 CFR 761.75 for proper off-site disposal. The remaining (non-TSCA-regulated) excavated soils will be transported to the Base landfill for proper disposal.

Following the excavation operation, the site would be restored by placing clean backfill (assumed to be from an on-Base borrow area) to bring the site back to it's original grade. All disturbed areas would be revegetated with native grasses and plant species to control erosion. Access roads or other infrastructure that are disturbed or destroyed in the excavation process would be restored to pre-excavation conditions. Site restoration activities would include wetland restoration under the "no access restrictions" option.

Under the "no access restrictions" option, no further land use controls would be necessary. Under the "access restrictions" option, land use controls would also include permanent access restrictions to the fenced wooded/wetland area and this area would be restricted from future development because contaminants exceeding remediation goals would remain on this portion of the site. It should be noted that the wetland area would be restricted from future development anyway unless wetland mitigation was implemented. Intrusive restrictions are not necessary because remediation goals developed for protection of the recreational receptor are also protective of the future construction worker. In both options, a fence will be installed parallel to the railroad

tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

4.2 Development of Groundwater Remedial Action Alternatives

No PCBs have been detected in groundwater at Site 84. In 1998, VOCs above screening criteria (benzene and chloroform) were detected at monitoring well clusters MW03/MW04 and MW11/MW12. These VOCs are believed to be related to the BTEX plume, near the former Building 45, that is currently being remediated under the UST Program. In 2001, 14 groundwater samples were collected and analyzed for VOCs, SVOCs, PCBs, herbicides and metals. Again, no PCBs were detected and this time there were no exceedances of screening criteria for any VOCs or SVOCs. However, pesticides were detected at relatively low levels, but above screening criteria, in two wells (gamma-chlordane in MW18 and heptachlor epoxide in MW20). In addition, metals were detected above screening criteria in twelve wells. Metals that exceeded criteria in one or more wells included aluminum, arsenic, iron, manganese, and thallium. Although metals exceeded screening criteria, they are present at very low levels that may be indicative of background concentrations. Due to the low concentrations of VOCs, pesticides and metals detected in site groundwater and the fact that the surficial aquifer is not used for potable purposes, active remediation of groundwater is not considered necessary or appropriate for Site 84.

Two groundwater RAAs were evaluated for Site 84. These include:

- GW RAA 1: No Action
- GW RAA 2: Groundwater Monitoring and Institutional Controls

4.2.1 GW RAA 1: *No Action*

Under the no action RAA, groundwater would not be actively remediated and would not be monitored. In addition, no institutional controls would be implemented to restrict aquifer use at Site 84. The no action alternative is required by the NCP to provide a baseline for comparison with other RAAs that provide a greater level of response. Since contaminants will remain at Site 84 under this RAA, the NCP [40 CFR 300.430(f)(4)] requires the lead agency to review the effects of this alternative at least once every five years.

4.2.2 GW RAA 2: Groundwater Monitoring and Institutional Controls

Under GW RAA 2, a groundwater monitoring program would be implemented at Site 84. The purpose of the groundwater monitoring program is to:

1) confirm or refute the presence of pesticides that were detected at low levels in MW18 and MW20,
2) monitor the detected VOCs to determine if their concentrations are still below screening criteria,
3) evaluate whether the metals that were detected in twelve wells at low levels, but above screening criteria, are indicative of background concentrations typically found at MCB Camp Lejuene.

Benzene and chloroform were detected at concentrations exceeding the NCWQS wells in 1998. Benzene was detected in GW03/GW04, and chloroform was detected in GW11/GW12. In 2001, pesticides were detected at relatively low levels, but above screening criteria, in two wells (gamma-chlordane in MW18 and heptachlor epoxide in MW20). Metals that exceeded criteria in one or more wells included aluminum, arsenic, iron, manganese, and thallium. Although metals exceeded criteria, they are present at very low levels that may be indicative of background concentrations. A Base-wide background study of metals in groundwater is currently being conducted at Camp Lejeune. Until this study is completed, it cannot be determined whether these metal concentrations are indicative of naturally occurring background concentrations. Therefore, a long-term monitoring program is not recommended at this time.

A short-term monitoring program, consisting of four additional groundwater sampling events is proposed at this time under this alternative. If the results of this short-term monitoring program indicate that pesticides or VOCs are still present at the site above screening criteria and/or that metals are present above Base background concentrations, then a focused long-term sampling program may be warranted.

The short-term sampling program will include the following 16 wells: GW03, GW04, GGW11, GW12, MW07, MW08, MW09, MW10, MW16, MW17, MW18, MW19, MW20, MW21, MW22, and MW23. The monitoring wells selected to be sampled under this program are shown on Figure 4-11. Samples from all wells will be analyzed for TAL metals (SW-846 Method 6010). In addition, samples from MW18 and MW20 will be analyzed for pesticides (SW-846 Method

8080) and samples from GW03, GW04, GW11, and GW12 will be analyzed for VOCs (SW-846, Method 8260).

Upon completion of the short-term groundwater monitoring program and the Base-wide groundwater background study, the data will be evaluated to determine if additional groundwater monitoring is necessary. A report will be prepared to document the short-term monitoring program results and to make recommendations for additional groundwater monitoring, if necessary.

If the groundwater monitoring program results indicate that pesticides or VOCs are present at the site above screening criteria and/or that metals are present above Base background concentrations, then aquifer use restrictions will be implemented to prohibit future use of the aquifer in the vicinity of Site 84 for potable purposes.

4.3 Screening of Remedial Action Alternatives

Typically, this section of the FS presents the initial screening of the potential RAAs. The objective of this screening is to make comparisons between similar alternatives so that only the most promising ones are carried through for further evaluation (USEPA, 1988). This screening is an optional step in the FS process, and is usually conducted if there are too many RAAs to carry through to detailed evaluations. In order to preserve a wide range of possible options for LANTDIV and the Base to consider, the screening of alternatives step was not conducted. All alternatives will be carried forward for the detailed evaluation.

5.0 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

This section presents the detailed analysis of the remedial action alternatives (RAAs) that were developed in Section 4.0. Section 5.1 presents an overview of evaluation criteria that will be used in the detailed analysis. Sections 5.2 and 5.3 present the individual and comparative detailed analyses for soil RAAs, respectively. Sections 5.4 and 5.5 present the individual and comparative detailed analyses for groundwater RAAs, respectively.

This detailed analysis has been conducted to provide sufficient information to compare the alternatives, select an appropriate remedy for the site, and demonstrate satisfaction of the CERCLA remedy selection requirements in the Record of Decision (ROD). The extent to which alternatives are assessed during the detailed analysis is influenced by the available data, the number and types of alternatives being analyzed, and the degree to which alternatives were previously analyzed during their development and screening (USEPA, 1988).

The detailed analysis of alternatives was conducted in accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988) and the NCP, including the February 1990 revisions. In conformance with the NCP, seven of the following nine criteria were used for the detailed analysis:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance (not evaluated at this time)
- Community acceptance (not evaluated at this time)

State acceptance and community acceptance are not evaluated. Regulatory agencies, including the NC DENR and the USEPA, are fully engaged and involved throughout the RI/FS process and are participants in the decision-making process. Community acceptance will be evaluated in the ROD by addressing comments received after the Restoration Advisory Board (public representatives) have reviewed the FS and Proposed Remedial Action Plan (PRAP).

5.1 Overview of Evaluation Criteria

The following paragraphs describe the evaluation criteria that are used in the detailed analysis.

Overall Protection of Human Health and the Environment: Overall protection of human health and the environment is the primary criteria that a remedial action must meet. A remedy is considered protective if it adequately eliminates, reduces, or controls all current and potential site risks posed through each exposure pathway at the site. A site where hazardous substances remain without engineering or institutional controls allows for unlimited exposure for human and environmental receptors. Adequate engineering controls, institutional controls, or some combination of the two, can be implemented to control exposure and thereby ensure reliable protection over time. In addition, implementation of a remedy cannot result in unacceptable short-term risks or cross-media impacts on human health and the environment.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs): Compliance with ARARs is one of the statutory requirements for remedy selection. Alternatives are developed and refined throughout the FS process to ensure that they will meet all ARARs or that there is a sound rationale for waiving an ARAR. During the detailed analysis, the alternatives will be analyzed based on federal and state contaminant-specific, action-specific, and location-specific ARARs that were presented in Section 2.0 of this FS. The primary ARARs for addressing Site 84 contaminants of concern in soils include TSCA regulations, USEPA guidance, and North Carolina UST Program requirements. For groundwater, the ARARs include the NCWQS and MCL guidance.

Long-Term Effectiveness and Permanence: This criterion reflects CERCLA's emphasis on implementing remedies that will ensure protection of human health and the environment over the long term. In evaluating alternatives for their long-term effectiveness and the degree of permanence they afford, the analysis will focus on the residual risks present at the site after the completion of the remedial action. The analysis will also include consideration of the following:

- Degree of threat posed by the hazardous substances remaining at the site.
- Adequacy of any controls (e.g., engineering and institutional controls) used to manage the hazardous substances remaining at the site.

- Reliability of those controls.

- Potential impacts on human health and the environment, should the remedy fail, based on assumptions included in the reasonable maximum exposure scenario.

Reduction of Toxicity, Mobility, or Volume Through Treatment: This criterion addresses the statutory preference for remedies that employ treatment as a principal element. The criterion ensures that the relative performance of the various treatment alternatives in reducing the toxicity, mobility, or volume will be assessed. Specifically, the analysis will examine the magnitude, significance, and irreversibility of reductions.

Short-Term Effectiveness: This criterion examines the short-term impacts associated with implementing the alternative. For example, implementation may impact the neighboring community, workers, or the surrounding environment. Short-term effectiveness also includes potential threats to human health and the environment associated with the excavation, treatment, and transportation of hazardous substances, the potential cross-media impacts of the remedy, and the time required to achieve protection of human health and the environment. Potential disruption of ecosystems must also be considered.

Implementability: Implementability considerations include the technical and administrative feasibility of the alternatives, as well as the availability of goods and services (including treatment, storage, or disposal capacity) associated with the alternative. Implementability considerations often affect the timing of remedial actions (e.g., limitations on the season in which the remedy can be implemented, the number and complexity of material handling steps, and the need to secure technical services). On-site activities must comply with the substantive portions of applicable permitting regulations.

Cost: Implementation costs includes all capital costs and annual operation and maintenance (O&M) costs incurred over the life of the project. The focus during the detailed analysis is on the present worth of these costs. Costs are used to select the most cost-effective alternative that will achieve the remedial action objectives. In accordance with USEPA guidance (USEPA, 1988), the cost estimates will have an accuracy of -30 to +50 percent. The exact accuracy of each cost estimate depends upon the assumptions made and the availability of costing information. The net present worth costs are calculated assuming a five percent discount factor and a zero percent inflation rate.

State Acceptance: This criterion reflects the statutory requirement to provide for state involvement. For this project, and other MCB Camp Lejeune projects, state involvement is achieved throughout the remedial process through Partnering activities. State comments will be addressed during the development of the FS, the PRAP, and the ROD, as appropriate.

Community Acceptance: This criterion addresses the community's comments on the remedial alternatives under consideration, where "community" is broadly defined to include all interested parties. Community comments are taken into account throughout the remedial process during periodic Restoration Advisory Board (RAB) meetings; however, formal public comment will not be received until after the public comment period for the PRAP.

5.2 Individual Analysis of Soil Alternatives

The following subsections present the detailed analysis of RAAs for Site 84 on an individual basis. This individual analysis includes a brief description of each RAA followed by an assessment of how well the RAA performs against the evaluation criteria.

5.2.1 RAA 1: No Action

Under the no action alternative, soil and sediment at Site 84 will remain as is. No physical remedial actions will be implemented.

Overall Protection of Human Health and the Environment: Under RAA 1, no physical remedial actions will be implemented to control potential exposure pathways or to reduce contaminant concentrations in soils. As a result, there will be no measurable reduction in potential human health or environmental risks.

Compliance with ARARs: Under RAA 1, no active effort will be made to reduce contaminant levels to below federal and state chemical-specific ARARs. Over an indefinite period of time, however, passive remediation, in the form of natural attenuation processes, may reduce PCB, TPH and PAH levels to below ARARs. No action-specific or location-specific ARARs apply to the no action alternative. Because contaminants will remain on site at levels exceeding requirements established by ARARs, RAA 1 will require five-year reviews to ensure that adequate protection of human health and the environment is maintained.

Long-Term Effectiveness and Permanence: Residual risk will remain at the site under the no action alternative as humans could potentially come in contact with the contaminated soils and sediments. The human health risk evaluation shows that soil remaining on site after the NTCRA contributes significantly to unacceptable human health risks only for potential future adult and child residents. The soil remaining after the NTCRA does not contribute to unacceptable health risks for the current receptors (Base personnel and recreational users) or for other future receptors (industrial/commercial or construction workers).

Under the no action alternative, any long-term or permanent effect on contaminant levels will depend on the effectiveness of natural attenuation. The extent to which natural attenuation may reduce contaminant levels, and the time it will take, are difficult to predict.

Reduction of Toxicity, Mobility, or Volume through Treatment: The no action alternative does not provide physical treatment processes for toxicity, mobility, or volume reduction of contaminated soil or sediment. Although passive treatment processes (i.e., natural attenuation) may eventually provide toxicity and volume reduction of the contaminated soil and sediments, the extent to which natural attenuation may reduce contaminant toxicity and volume is difficult to predict. Although RAA 1 provides no means for measurement, this alternative may in time satisfy the statutory preference for treatment through natural attenuation.

Short-Term Effectiveness: As there are no physical remedial action activities associated with RAA 1, there are no increased short-term potential risks to workers or the community. Also, there will be no additional short-term environmental impacts.

Implementability: The no action alternative is easily implemented since no additional construction or operation activities will be conducted. In terms of administrative feasibility, RAA 1 should not require additional coordination with other agencies, although a waiver of the state ARARs may be required since contaminants exceeding these ARARs will be left on-site indefinitely. The availability of services, materials, and/or technologies is not applicable to this alternative.

Cost: There are no capital costs or O&M costs associated with this alternative. Therefore, the net present worth (NPW) is $0.

5.2.2 RAA 2: Excavation and Landfill Disposal (High-Occupancy Land Use, No Access Restrictions) and RAA 2a: Excavation and Landfill Disposal (High-Occupancy Land Use, Access Restrictions)

RAA 2 involves the excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for high-occupancy land use. The "no access restrictions" option involves a site-wide excavation of soil that exceeds cleanup criteria (Figure 4-1). An "access restrictions" option also has been developed to reduce costs, preserve wetlands and wildlife habitats, and maintain site aesthetics. In this option, the upper northwest corner of the site would be fenced and designated as low-occupancy (Figure 4-2), and the remainder of the site would be excavated to meet remediation goals for high-occupancy land use.

Under both options, the lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified and removed, and the lagoon will be backfilled and graded for surface drainage. Under both options, confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for pesticides, PCBs, PAHs and TPH. Excavated soils would be transported to a TSCA-permitted chemical waste landfill or the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions (to include wetland restoration under the "no access restrictions" option). In both options, a fence will be installed parallel to the railroad tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

Overall Protection of Human Health and the Environment: Because RAA 2 provides either institutional controls or excavation/off-site disposal of contaminated soils and lagoon sediments, this RAA will reduce potential risks to human health and the environment. Exposure pathways are eliminated with the site-wide excavation of a "no access restrictions" option. In the "access restrictions" option, institutional controls such as fencing and signs reduce exposure pathways in the designated low-occupancy area. Ecological risk will also be eliminated in areas of the site that are excavated.

Compliance With ARARs: In the RAA 2 "no access restrictions" option, contaminated soils that exceed EPA Region IX Residential PRGs, TSCA cleanup goals for PCBs for high occupancy areas (1 ppm) and North Carolina UST regulations are removed from the site. In the "access restrictions" option, these regulated contaminated soils are either removed, or institutional controls designate areas in which they still remain on site at concentrations less than designated low-occupancy remedial goals. Several potential location-specific and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport, and disposal activities. The "no access restrictions" option will also involve destruction and subsequent mitigation of wetlands and ecosystems. Activities at the site will be implemented such that all ARAR requirements will be met.

Long-Term Effectiveness and Permanence: The excavation and disposal "no access restrictions" option will be an effective and permanent remedial action. The contaminated soil will be removed from the site and placed in an off-site disposal facility where contact with human and ecological receptors will be eliminated. This alternative will be effective in the long-term because the contaminants will be permanently removed from the Site 84 and will no longer pose a potential risk to human health or the environment.

For the "access restrictions" option, contamination remains in the upper northwest corner of the site. No action will be taken to eliminate this contamination, but only to eliminate the exposure pathways by restricting access with a fence. This will have a lower level of long-term effectiveness than excavation, but is appropriate for the low levels of contamination found in this portion of the site.

Reduction of Toxicity, Mobility, or Volume through Treatment: Neither toxicity, mobility, nor volume of contaminants will be reduced through treatment under either option of this alternative because no treatment technologies will be used. However, the physical removal of the soil will eliminate the availability of contaminants to human or ecological receptors. Similarly, there will be no mobility of contaminants that exceed clean-up goals at the site because they will be removed. The volume of the contaminated soil will not be reduced, but the soil will be removed from the site. Therefore, the volume, mobility, and toxicity of contaminants at the site will be reduced, even though the contaminated soil itself will not be affected.

Short-Term Effectiveness: In the short-term, construction workers and ecological receptors may be exposed to disturbed contaminated soil. Exposures to human health and the environment will

be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. If a "no access restrictions" option is selected, ecological damage will occur to the habitats in the wetland/wooded areas. This alternative can be implemented in less than one year. Upon completion, this alternative will be effective for protecting human health and the environment.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport contaminated soil/sediments and to place, contour, and seed the clean backfill and topsoil for areas under the "no access restrictions" and "access restrictions" options. The institutional controls for the "access restrictions" option are also easy to implement.

Cost: Estimated capital and O&M costs for RAA 2 and RAA 2a are presented on Tables 5-1 and 5-2, respectively. The estimated total net present worth cost for RAA 2 is $1,311,100 and for RAA 2a is $1,012,700.

5.2.3 RAA 3: Excavation and Capping (High-Occupancy Land Use, No Access Restrictions) and RAA 3a: Excavation and Capping (High-Occupancy Land Use, Access Restrictions)

In RAA 3, contaminated soils and lagoon sediments that exceed 10 ppm PCBs will be excavated and disposed off site. The remaining contaminated soils that exceed 1 ppm PCBs, North Carolina UST regulations, and EPA Region IX Residential PRGs will be capped. This alternative also includes both "no access restrictions" and "access restrictions" options. The "no access restrictions" option involves a site-wide excavation and/or capping of soil that exceeds cleanup criteria (Figure 4-3). At completion, the entire site would be designated as high-occupancy. Because the excavation and capping of heavily wooded and wetlands areas is costly, destroys habitats and may diminish the aesthetics of the site, an "access restrictions" option has been added to this alternative. In this option (Figure 4-4), a smaller portion of the site is to be designated for excavation and capping. The upper northwest corner of the site will be fenced and proper access restrictions will be established. This fenced portion of the site will be designated as low-occupancy.

In both RAA options, the lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified and removed, and the lagoon will be backfilled and graded for surface drainage. Confirmatory sampling will take place following excavation to ensure that all contaminants exceeding the 10 ppm PCB remediation goal have been excavated. Excavated soils would be disposed of at a TSCA-permitted chemical waste landfill or the Base landfill. Following the excavation operation, the site would be restored to its pre-excavation conditions (to include wetland restoration under the "no access restrictions" option). In both options, a fence will be installed parallel to the railroad tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

Overall Protection of Human Health and the Environment: RAA 4 provides institutional controls and excavation/capping of contaminated soils and lagoon sediments, therefore, this RAA will reduce potential risks to human health and the environment. The capping alternative will prevent human and ecological receptors from coming into contact with soil contaminants. Soil invertebrates usually inhabit the top 6 inches to one foot of soil. The contaminated soil will be covered with one foot of clean backfill and then 6 inches of topsoil. The soil invertebrates will move into the upper portion of the newly installed soil cover and will no longer inhabit the contaminated soil. With proper maintenance of the soil cover, human health and the environment will be protected under this alternative. Institutional controls will include excavation restrictions that will be implemented at the site to protect the cap against possible intrusive activities.

Compliance With ARARs: Chemical-specific ARARs will be met in this alternative. TSCA guidelines for high-occupancy cleanup indicate that the site only needs to be excavated to 10 ppm PCBs if a soil capping alternative is selected. Several potential location-specific and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport, and disposal activities. The "no access restrictions" options will also involve destruction and subsequent mitigation of wetlands. Activities at the site will be implemented such that all ARAR requirements are met.

Long-Term Effectiveness and Permanence: A soil cover will be effective for protecting human health and the environment in the long term if the cap is properly maintained. The soil cover will prevent human and ecological exposure to contaminated soils provided that the soil cover is properly installed and maintained. For the "access restrictions" option, contamination remains in the upper northwest corner of the site. No action will be taken to eliminate this contamination,

but only to eliminate the exposure pathways by restricting access with a fence. This will have a lower level of long-term effectiveness than excavation, but is appropriate for the low levels of contamination found in this portion of the site.

Reduction of Toxicity, Mobility, or Volume Through Treatment: The toxicity of contaminants will not be reduced by this alternative because the contaminants will not be transformed into less toxic forms or destroyed by any physical, chemical, or thermal process. However, because ecological receptors in the soil may migrate away from the contaminated soils and into the soil cover, receptors will remove themselves from the contaminants. Also, areas of high PCB concentration will be excavated and disposed. Although this is not a treatment technology, the toxicity of Site 84 soils and sediments will be reduced in this manner. The mobility of contaminants will be reduced because the soil cover will prevent wind and water erosion, thereby preventing contaminated soil from migrating via sedimentation and erosion processes. However, soluble contaminants could leach due to infiltration of rainwater through the soil cover.

Short-Term Effectiveness: In the short-term, construction workers and ecological receptors may be exposed to disturbed contaminated soils. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. If a "no access restrictions" option is selected, ecological damage will occur to the habitats in the wetland/wooded areas. It is estimated that this alternative can be implemented in less than one year. Upon completion, this alternative will be effective for protecting human health and the environment.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport contaminated soil/sediment and to place, contour and seed the clean backfill and topsoil. For the "access restrictions" option, fencing and signs will also be required. These access restrictions are also easily implemented.

Cost: Estimated capital and O&M costs for RAA 3 and RAA 3a are presented on Tables 5-3 and 5-4, respectively. The estimated total net present worth cost for RAA 3 is $1,025,800 and for RAA 3a is $862,400.

5.2.4 RAA 4: Excavation and Landfill Disposal (Low-Occupancy Land Use)

RAA 4 is appropriate for future low-occupancy land use. In this alternative, soils exceeding EPA industrial land use guidance for PCBs (10 ppm), UST program regulations for TPH and Region IX Industrial PRGs will be excavated and removed from the site (Figure 4-5). Since all detected contaminates in the wetlands/wooded area are below remediation goals, there is no need to have an "access restrictions" option for this alternative. The excavated soils and sediments will be separated into TSCA and non-TSCA regulated piles and disposed of properly. The lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified and removed, and the lagoon will be backfilled and graded for surface drainage. Confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for pesticides, PCBs, PAHs and TPH. Excavated soils would be transported to a TSCA-permitted chemical waste landfill or the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions. Site perimeter fencing will be constructed to protect recreational trespassers. Because contaminated soils will remain at the site, land use restrictions will be required.

Overall Protection of Human Health and the Environment: RAA 4 provides institutional controls and excavation/off-site disposal of contaminated soils and lagoon sediments, thereby reducing potential risks to human health and the environment. All soils exceeding remedial goals for low-occupancy land use will be removed from the site in order to protect potential human receptors and eliminate any exposure pathway to such contamination. Additionally, institutional controls will include land use restrictions that would limit future land use to low-occupancy uses such as a non-office warehouse, equipment storage area, or electrical substation. The entire site perimeter is fenced, therefore reducing exposure pathways of recreational trespassers who may spend more than 6.7 hours/week at the site. As contaminated soils may remain on site, excavation restrictions will be implemented at the site to prevent possible exposure to contaminated soil during intrusive activities.

Compliance with ARARs: Because some soil will be excavated and removed from the site, soil contaminant concentrations will have to meet requirements for handling and disposal. Several potential location-specific and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport,

and disposal activities. Activities at the site will be implemented such that all ARAR requirements will be met.

Long-Term Effectiveness and Permanence: The removal of designated areas of contaminated soil that exceed remediation goals for low-occupancy land use would permanently and effectively remove these contaminants from the site since they would be transported to an appropriate landfill. The remainder of the contaminated soils would remain on site. Land use controls would restrict future intrusive activities (e.g., excavation, installation of wells, or construction, other than for future remediation purposes) and the site would be restricted to future low-occupancy land uses. These restrictions would be permanent.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Excavation and disposal will not reduce the toxicity, mobility, or volume of contaminants through treatment because excavation and disposal are not treatment technologies. However, the physical removal of the soil will eliminate the availability of contaminants to human or ecological receptors. Similarly, there will be no mobility of contaminants that exceed clean-up goals at the site because they will be removed. Volume of the contaminated soil will not be reduced, but the soil will be removed from the sites. Therefore, the volume, mobility, and toxicity of contaminants at the site will be reduced, even though the contaminated soil itself will not be affected through treatment.

Short-Term Effectiveness: In the short term, construction workers and ecological receptors may be exposed to disturbed contaminated soil. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. It is estimated that this alternative can be implemented in less than one year.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport contaminated soils/sediments and to place, contour, and seed the clean backfill and topsoil.

Cost: Estimated capital and O&M costs for RAA 4 are presented on Table 5-5. The estimated total net present worth cost for RAA 4 is $820,600.

5.2.5 RAA 5: Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)

RAA 5 is appropriate for a future low-occupancy land use. In this alternative, designated "hot spots" will be excavated from the site. These areas are shown on Figure 4-6. These soils to be excavated exceed North Carolina UST regulations, EPA Region IX Industrial PRGs or TSCA guidelines for PCBs for low-occupancy land use without additional controls (25 ppm). The excavated soils and sediments will be separated into TSCA and non-TSCA regulated piles and disposed of properly. The lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified and removed, and the lagoon will be backfilled and graded for surface drainage. Confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for pesticides, PCBs, PAHs and TPH. Excavated soils would be transported to a TSCA-permitted chemical waste landfill or the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions. Site perimeter fencing will be constructed to protect recreational trespassers. Because contaminated soils will remain at the site, land use restrictions will be required.

Overall Protection of Human Health and the Environment: RAA 5 provides institutional controls and excavation/off-site disposal of contaminated soils and lagoon sediments, thereby reducing potential risks to human health and the environment. All soils exceeding remedial goals for low-occupancy land use will be removed from the site in order to protect potential human receptors and eliminate any exposure pathway to such contamination. Additionally, institutional controls will include land use restrictions that would limit future land use to low-occupancy uses such as a non-office warehouse, equipment storage area, or electrical substation. Recreational trespassers potentially may be exposed to PCB concentrations up to 25 ppm. Therefore, the entire site perimeter is fenced to protect potential recreational trespassers. As contaminated soils may remain on site, excavation restrictions will be implemented at the site to prevent possible exposure to contaminated soil during intrusive activities.

Compliance with ARARs: Because some soil will be excavated and removed from the site, soil contaminant concentrations will have to meet requirements for handling and disposal. Several potential location-specific and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport, and disposal activities. Activities at the site will be implemented such that all ARAR requirements will be met.

Long-Term Effectiveness and Permanence: The removal of designated "hot spots" of contaminated soil that exceed remediation goals for low-occupancy land use would permanently and effectively remove these contaminants from the site since they would be transported to an appropriate landfill. The remainder of the contaminated soils would remain on site. Land use controls would restrict future intrusive activities (e.g., excavation, installation of wells, or construction, other than for future remediation purposes) and the site would be restricted to future low-occupancy land uses. These restrictions would be permanent.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Excavation and disposal will not reduce the toxicity, mobility, or volume of contaminants through treatment because excavation and disposal are not treatment technologies. However, the physical removal of the soil will eliminate the availability of contaminants to human or ecological receptors. Similarly, there will be no mobility of contaminants that exceed clean-up goals at the site because they will be removed. Volume of the contaminated soil will not be reduced, but the soil will be removed from the sites. Therefore, the volume, mobility, and toxicity of contaminants at the site will be reduced, even though the contaminated soil itself will not be affected through treatment.

Short-Term Effectiveness: In the short term, construction workers and ecological receptors may be exposed to disturbed contaminated soil. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. It is estimated that this alternative can be implemented in less than one year.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport contaminated soils/sediments and to place, contour, and seed the clean backfill and topsoil.

Cost: Estimated capital and O&M costs for RAA 5 are presented on Table 5-6. The estimated total net present worth cost for RAA 5 is $786,000.

5.2.6 RAA 6: Hot Spot Removal and Fencing (Low-Occupancy Land Use)

RAA 6 may be implemented for future low-occupancy land uses. It is similar to RAA 5 in that certain "hot spots" will be excavated and transported to a proper off-site disposal facility.

However, in this RAA, the site perimeter will be fenced to reduce exposure pathways. Under TSCA guidelines, if institutional controls are in place at a site with a low-occupancy land use, PCBs may remain on site up to 50 ppm. The excavation area of RAA 6 can therefore be reduced in this RAA (Figure 4-7). Therefore, any soils exceeding 50 ppm PCBs, EPA Region IX Industrial PRGs or North Carolina UST cleanup guidelines will be excavated and transported to a TSCA-permitted chemical waste landfill or the Base landfill for proper disposal. A fence will be constructed and signs posted along the entire site perimeter. The lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified in place and the lagoon will be backfilled and graded for surface drainage. Following the excavation operation, the site would be restored to its pre-excavation conditions. Because contaminated soils will remain at the site, land use restrictions will be required.

Overall Protection of Human Health and the Environment: RAA 6 provides institutional controls and excavation/off-site disposal of designated "hot spots", thereby reducing potential risks to human health and the environment. In excavating designated "hot spots" and fencing the site perimeter (Figure 4-7), the exposure pathways for contaminants exceeding low-occupancy land use criteria for this site are eliminated. Therefore, the potential low-occupancy receptors are appropriately protected. Additionally, institutional controls will include land use restrictions that would limit future land use to low-occupancy uses such as a non-office warehouse, equipment storage area, or electrical substation. As contaminated soils may remain on site, excavation restrictions will be implemented at the site to prevent possible exposure to contaminated soil during intrusive activities.

Compliance With ARARs: Because soil will be excavated and removed from the site, soil contaminant concentrations will have to meet requirements for handling and disposal. Several potential location and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving activities. Activities at the site will be implemented such that all ARAR requirements will be met.

Long-Term Effectiveness and Permanence: The removal of designated "hot spots" of contaminated soil that exceed remediation goals for low-occupancy land use would permanently and effectively remove these contaminants from the site since they would be transported to an appropriate landfill. The remainder of the contaminated soils would remain on site. Land use controls would restrict future intrusive activities (e.g., excavation, installation of wells, or construction, other than for future remediation purposes) and the site would be restricted to future low-occupancy land uses. These restrictions would be permanent.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Excavation and disposal will not reduce the toxicity, mobility, or volume of contaminants through treatment because excavation and disposal are not treatment technologies. However, the physical removal of the soil will eliminate the availability of contaminants to human or ecological receptors. Similarly, there will be no mobility of contaminants that exceed clean-up goals at the site because they will be removed. The volume of the contaminated soil at the site will be reduced because the soil will be removed from the site. Therefore, the volume, mobility, and toxicity of contaminants at the site will be reduced, even though the contaminated soil itself will not be affected through treatment.

Short-Term Effectiveness: In the short-term, construction workers and ecological receptors may be exposed to disturbed contaminated soil. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. It is estimated that this alternative can be implemented in less than one year.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport designated soils, and to place, contour, and seed the clean backfill and topsoil.

Cost: Estimated capital and O&M costs for RAA 6 are presented on Table 5-7. The estimated total net present worth cost for RAA 6 is $540,200.

5.2.7 RAA 7: Hot Spot Removal and Capping (Low-Occupancy Land Use)

RAA 7 is a low-occupancy land use capping option. Under TSCA guidance, soils that have PCB contamination less than 100 ppm may remain on site if the site is capped and intended for future low-occupancy land use. Therefore, in this alternative, soils exceeding 100 ppm PCBs will be excavated and removed off-site and soils that exceed 25 ppm PCBs, TPH cleanup levels or EPA Region IX Industrial PRGs will be capped, as shown on Figure 4-8. Land use restrictions will be necessary for this alternative since contaminated soil presents a human health risk and it will remain on site. The lagoon will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified in place and the lagoon will be backfilled and graded for surface drainage. The site perimeter will be fenced to protect recreational trespassers.

Confirmatory sampling will take place following excavation to ensure that all contaminants exceeding the 100 ppm PCB remediation goal have been excavated. Excavated soils would be transported to a TSCA-permitted chemical waste landfill for proper disposal. Following the excavation operation, the site would be capped with 12 inches of clean backfill and 6 inches of topsoil and would be vegetated to minimize erosion.

Overall Protection of Human Health and the Environment: RAA 7 provides institutional controls and excavation/capping of contaminated soils and lagoon sediments, therefore, this RAA will reduce potential risks to human health and the environment. The capping alternative will prevent "low-occupancy" human and ecological receptors from coming into contact with soil contaminants. The soil cover will prevent exposure through dermal contact, ingestion and inhalation. With proper maintenance of the soil cover, human health and the environment will be protected under this alternative. The site perimeter will be fenced, protecting potential recreational trespassers. Institutional controls will include excavation restrictions that will be implemented at the site to protect the cap against possible intrusive activities.

Compliance With ARARs: Chemical-specific ARARs will be met in this alternative. TSCA guidelines for low-occupancy cleanup indicate that PCB-contaminated soil only needs to be excavated to 100 ppm if a soil capping alternative is selected. Several potential location and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport, and disposal activities. Activities at the site will be implemented such that all ARAR requirements are met.

Long-Term Effectiveness and Permanence: A soil cover will be effective for protecting human health and the environment in the long term if the cap is properly maintained. Human and ecological dermal, ingestion, and inhalation contact with contaminated soils will be prevented by the soil cover as long as the contaminated soils are not exposed, and the land is regulated for low-occupancy use. Should the cap fall into disrepair, human and ecological receptors may not be protected over the long term.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Capping is not a treatment alternative, and the toxicity of contaminants will not be reduced by this alternative because the contaminants will not be transformed into less toxic forms or destroyed by any physical, chemical, or thermal process. However, because ecological receptors in the soil may migrate away from the contaminated soils and into the soil cover, receptors will remove themselves from

the contaminants. Also, areas of high PCB concentration will be excavated and removed off-site. The toxicity of Site 84 soils will be reduced in this manner. The mobility of contaminants will be reduced because the soil cover will prevent wind and water erosion, thereby preventing contaminated soil from migrating via sedimentation and erosion processes. However, soluble contaminants could leach due to infiltration of rainwater through the soil cover.

Short-Term Effectiveness: In the short-term, construction workers and ecological receptors may be exposed to disturbed contaminated soils. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. It is estimated that this alternative can be implemented in less than one year.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to complete any excavation necessary and to place, contour and seed the clean backfill and topsoil.

Cost: Estimated capital and O&M costs for RAA 7 are presented on Table 5-8. The estimated total net present worth cost for RAA 7 is $517,800.

5.2.8 RAA 8: Excavation and Landfill Disposal (Recreational Land Use, No Access Restrictions) and RAA 8a: Excavation and Landfill Disposal (Recreational Land Use, Access Restrictions)

RAA 8 involves the excavation of soils and lagoon sediments that contain contaminant concentrations in excess of remediation goals for recreational land use. The "no access restrictions" option involves a site-wide excavation of soil that exceeds cleanup criteria (Figure 4-9). An "access restrictions" option also has been developed to reduce costs, preserve wetlands and wildlife habitats, and maintain site aesthetics. In this option, the upper northwest corner of the site would be fenced and designated as low-occupancy (Figure 4-10), and the remainder of the site would be excavated to meet remediation goals for recreational land use.

Under both options, the lagoon water will be pumped and the water sent to the Base water treatment facility. Lagoon sediments (approximately 2 ft deep) will be solidified and removed, and the lagoon will be backfilled and graded for surface drainage. Under both options,

confirmatory sampling will take place to ensure that all contaminants exceeding remediation goals have been excavated. Samples will be analyzed for pesticides, PCBs, PAHs and TPH. Excavated soils would be transported to a TSCA-permitted chemical waste landfill or the Base landfill for proper disposal. Following the excavation operation, the site would be restored to its pre-excavation conditions (to include wetland restoration under the "no access restrictions" option). In both options, a fence will be installed parallel to the railroad tracks along the northern border of Site 84 to provide a barrier between the site and the rails-to-trails project.

Overall Protection of Human Health and the Environment: Because RAA 8 provides institutional controls and excavation/off-site disposal of contaminated soils and lagoon sediments, this RAA will reduce potential risks to human health and the environment. Exposure pathways are eliminated with the site-wide excavation of a "no access restrictions" option. In the "access restrictions" option, engineering controls such as fencing and signs reduce exposure pathways in the designated low-occupancy area. Ecological risk will also be eliminated in areas of the site that are excavated.

Compliance With ARARs: In the RAA 8 "no access restrictions" option, contaminated soils that exceed calculated risk-based cleanup coals (Table 2-14) are removed from the site. In the "access restrictions" option, these regulated contaminated soils are either removed, or institutional controls designate areas in which they still remain on site at concentrations less than designated low-occupancy remedial goals. Several potential location-specific and action-specific ARARs identified for this site will be applicable or relevant and appropriate under this RAA because the alternative includes earth moving, transport, and disposal activities. The "no access restrictions" option will also involve destruction and subsequent mitigation of wetlands and ecosystems. Activities at the site will be implemented such that all ARAR requirements will be met.

Long-Term Effectiveness and Permanence: The excavation and disposal "no access restrictions" option will be an effective and permanent remedial action. The contaminated soil will be removed from the site and placed in an off-site disposal facility where contact with human and ecological receptors will be eliminated. This alternative will be effective in the long-term because the contaminants will be permanently removed from Site 84 and will no longer pose a potential risk to human health or the environment.

For the "access restrictions" option, contamination remains in the upper northwest corner of the site. No action will be taken to eliminate this contamination, but only to eliminate the exposure

pathways by restricting access with a fence. This will have a lower level of long-term effectiveness than excavation, but is appropriate for the low levels of contamination found in this portion of the site.

Reduction of Toxicity, Mobility, or Volume through Treatment: Neither toxicity, mobility, nor volume of contaminants will be reduced through treatment under either option of this alternative because no treatment technologies will be used. However, the physical removal of the soil will eliminate the availability of contaminants to human or ecological receptors. Similarly, there will be no mobility of contaminants that exceed clean-up goals at the site because they will be removed. The volume of the contaminated soil will not be reduced, but the soil will be removed from the site. Therefore, the volume, mobility, and toxicity of contaminants at the site will be reduced, even though the contaminated soil itself will not be affected.

Short-Term Effectiveness: In the short-term, construction workers and ecological receptors may be exposed to disturbed contaminated soil. Exposures to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. If a "no access restrictions" option is selected, ecological damage will occur to the habitats in the wetland/wooded areas. This alternative can be implemented in less than one year. Upon completion, this alternative will be effective for protecting human health and the environment.

Implementability: This alternative is easily implemented because no active treatment technologies will be used. Commonly used earth moving equipment and site work procedures will be employed to excavate and transport contaminated soil/sediments and to place, contour, and seed the clean backfill and topsoil for areas under the "no access restrictions" and "access restrictions" options. The institutional controls for the "access restrictions" option are also easy to implement.

Cost: Estimated capital and O&M costs for RAA 8 and RAA 8a are presented on Tables 5-9 and 5-10, respectively. The estimated total net present worth cost for RAA 8 is $1,181,100 and for RAA 8a is $996,900.

5.3 Comparative Analysis of Soil Alternatives

This section presents a comparative analysis of the eight RAAs presented for soil at Site 84. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each RAA. Thus, the seven previously introduced criteria used for the detailed analysis will be the basis for the following comparative analysis.

5.3.1 Overall Protection of Human Health and the Environment

Each alternative will protect human health and the environment for the desired future land use with the exception of RAA 1, the no action alternative. The RAA 2 and RAA 8 "no access restrictions" options are most protective of human health and the environment because in these alternatives soils and lagoon sediments exceeding high occupancy or recreational cleanup goals are either removed from the site or treated. RAA 4, RAA 5 and RAA 6 are protective of human health because these alternatives include removal of soils and lagoon sediments that exceed low occupancy cleanup goals. RAAs 3, 3a, and 7 offer reduced or eliminated exposure pathways for high occupancy (RAA 3 and RAA 3a) and low occupancy (RAA 7) land uses. RAA 2, RAA 3 and RAA 8 also have an "access restrictions" option in which entire site contamination is excavated, treated, or capped except for the upper northwest corner of the site. This area is protective of human health and the environment through access restrictions and institutional controls.

Human health risk values generated for soil and sediment at Site 84 only exceeded acceptable limits under the future residential adult and child scenario for soil and sediments exposure. Risk values for soils and sediments generated under the current land use and future construction worker and commercial worker scenarios at Site 84 were within acceptable limits.

5.3.2 Compliance with ARARs

All of the RAAs, except for no action, meet chemical-specific ARARs and remedial goals for the desired future land use, as presented in Section 2.0 of this FS. PCBs are relatively stable in the environment and are not likely to naturally attenuate to acceptable levels under the no action alternative. Location-specific and action-specific ARARs are met as applicable within each RAA.

5.3.3 Long-Term Effectiveness and Permanence

The no action alternative will not be effective over the long term in protecting human health and the environment because the contaminants will remain at the site and will not be contained, removed or treated. Both options for RAA 2 and RAA 8 will be effective in the long term because site contamination is removed to meet high-occupancy or recreational land use cleanup levels. RAA 3, a high-occupancy capping alternative, will be effective in the long term if the soil cover is properly maintained into the future. RAAs 4, 5, and 6 will be effective for low-occupancy future land uses because site contamination is removed to meet low-occupancy needs with appropriate land use controls. RAA 7, a low-occupancy capping option, will be effective for low occupancy land use if the soil cover is properly maintained into the future.

The "no access restrictions" options of RAA 2 and RAA 8 offer the most effective long-term permanence and effectiveness. The "access restrictions" option of these two RAAs will additionally require partial access restrictions, if selected. Excavation restrictions are placed on RAAs 3, 4, 5, 6 and 7. Each of the low-occupancy alternatives (RAAs 4 5, 6, and 7) requires future land use restrictions. The required land use controls for each RAA can be referenced in Table 4-1.

5.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The no action alternative will not reduce the toxicity, mobility, or volume of contaminated soil at the site. RAAs 3 and 7 (capping for high and low-occupancy, respectively) will reduce the mobility of contaminants but not the toxicity or volume of the soil itself. However, because capping will reduce contact with contaminated soil by human and ecological receptors, the potential toxicity will be reduced.

The "no access restrictions" option of RAAs 2 and 8 will reduce the toxicity, mobility, or volume through removal of contaminants from the site. The "access restrictions" option for RAA 2 and RAA 8 will excavate and remove or treat contaminants in all but the upper northwest corner of the site. This portion of the site will be fenced, thereby eliminating the exposure pathway and thus the potential toxicity to human receptors. RAAs 4, 5 and 6 will reduce the volume, toxicity or mobility of the soil by excavation and removal, however, the toxicity is reduced only to levels acceptable for low-occupancy land uses.

5.3.5 Short-Term Effectiveness

The no action alternative is not effective for protecting human health and the environment in the short term. The contaminants will remain in place and will not be disturbed. The other alternatives all require excavation of contaminated soil that could increase the exposure of construction workers and ecological receptors to contaminated soils in the short term. However, exposure to human health and the environment will be minimized by the proper use of personal protective equipment, erosion and sediment control measures, and dust controls. It is estimated that most of the alternatives can be implemented in less than one year.

5.3.6 Implementability

The no action alternative requires no effort because no changes will be made to affect current site conditions. All of the other alternatives have an easy to moderate level of difficulty to implement, and require varying amounts of excavation.

Land use controls are not required for the "no access restrictions" option of RAA 2 and the no action alternative. The "access restrictions" option of RAA 2 will require partial access restrictions. Intrusive (excavation) restrictions are placed on RAA 3, 4, 5, 6 and 7. Each of the low-occupancy and recreational alternatives (RAAs 4, 5, 6, 7 and 8) requires land use restrictions. The required land use controls are easily implemented.

5.3.7 Cost

Estimated capital and O&M costs for each RAA are presented on Tables 5-1 through 5-10. The estimated total net present worth cost for each RAA is provided below.

RAA #	RAA Name	RAA Cost
RAA 1	No Action	$0
RAA 2	Excavation and Landfill Disposal (High-Occupancy, No Access Restrictions)	$1,311,100
RAA 2a	Excavation and Landfill Disposal (High-Occupancy, Access Restrictions)	$1,012,700
RAA 3	Excavation and Capping (High-Occupancy, No Access Restrictions)	$1,025,800
RAA 3a	Excavation and Capping (High-Occupancy, Access Restrictions)	$862,400
RAA 4	Excavation and Landfill Disposal (Low-Occupancy Land Use)	$820,600
RAA 5	Hot Spot Removal and Institutional Controls (Low-Occupancy Land Use)	$786,000
RAA 6	Hot Spot Removal and Fencing (Low-Occupancy Land Use)	$540,200
RAA 7	Hot Spot Removal and Capping (Low-Occupancy Land Use)	$517,800
RAA 8	Excavation and Landfill Disposal (Recreational, No Access Restrictions)	$1,181,100
RAA 8a	Excavation and Landfill Disposal (Recreational, Access Restrictions)	$996,900

5.4 Individual Analysis of Groundwater Alternatives

The following subsections present the detailed analysis of Groundwater RAAs for Site 84 on an individual basis. This individual analysis includes a brief description of each RAA followed by an assessment of how well the RAA performs against the evaluation criteria.

5.4.1 GW RAA 1: No Action

Under the no action GW RAA, groundwater would not be actively remediated and would not be monitored. In addition, no institutional controls would be implemented to restrict aquifer use.

Overall Protection of Human Health and the Environment: Potential ingestion of shallow groundwater contributes to potentially unacceptable risk values for receptors who may use this water for potable use, however, it is highly unlikely that this scenario will occur because the groundwater is not used as a potable source. Under the no action alternative, no remedial actions will be implemented and no action will be taken to monitor groundwater or to control potential exposure pathways. As a result, there will be no measurable reduction in potential human health or environmental risks. Any long-term or permanent effect on contaminant levels will depend on the effectiveness of natural attenuation. The extent to which natural attenuation may reduce contaminant levels, and the time it will take, are difficult to predict.

Compliance with ARARs: No active effort will be made to reduce contaminant levels to below federal and state chemical-specific ARARs. No action-specific or location-specific ARARs apply to the no action alternative. Because contaminants will remain on site at levels exceeding requirements established by ARARs, RAA 1 will require five-year reviews to ensure that adequate protection of human health and the environment is maintained.

Long-Term Effectiveness and Permanence: This alternative does not include aquifer use restrictions and therefore would not be effective in protecting potential future receptors. Potential ingestion of shallow groundwater contributes to potentially unacceptable risk values, however, it is highly unlikely that this scenario will occur because the on-site groundwater is not used as a potable source.

Reduction of Toxicity, Mobility, or Volume through Treatment: The no action alternative will not reduce the toxicity, mobility, or volume of contaminants through treatment. However, contaminant concentrations may decrease over time through dispersion and other physical processes.

Short-Term Effectiveness: As there are no physical remedial action activities associated with RAA 1, there are no increased short-term potential risks to workers or the community. Also, there will be no additional short-term environmental impacts.

Implementability: The no action alternative is easily implemented since no remedial, monitoring, or institutional activities will be conducted. The availability of services, materials, and/or technologies is not applicable to this alternative.

Cost: There are no capital costs or O&M costs associated with this alternative. Therefore, the net present worth (NPW) is $0.

5.4.2 GW RAA 2: Groundwater Monitoring and Institutional Controls

Under GW RAA 2, a short-term groundwater monitoring program is proposed. Monitoring wells to be included in the program and results from previous monitoring are shown on Figure 4-11. If the groundwater monitoring results indicate that VOCs or pesticides are present at the site above screening criteria and/or that metals are present above Base background concentrations, then a focused long-term sampling program may be warranted. Aquifer use restrictions will be

implemented to prohibit future use of the aquifer in the vicinity of Site 84 for potable purposes until four consecutive rounds of sampling demonstrate that the COCs are below screening criteria or base background levels.

Overall Protection of Human Health and the Environment: This alternative provides protection to human health and the environment by implementation of a groundwater monitoring program and by restricting future aquifer use via institutional controls.

Compliance with ARARs: No active effort will be made to reduce contaminant levels to below federal and state chemical-specific ARARs. However, a groundwater monitoring program will confirm or refute the presence of pesticides and VOCs above chemical-specific ARARs and will determine whether metals detected above chemical-specific ARARs are representative of background conditions. No action-specific or location-specific ARARs apply to this alternative.

Long-Term Effectiveness and Permanence: This alternative provides long-term protectiveness via a provision for aquifer use restrictions to protect potential future receptors, even though use of shallow groundwater for potable purposes is highly unlikely to occur at this site.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative will not reduce the toxicity, mobility, or volume of contaminants through treatment. However, contaminant concentrations may decrease over time through dispersion and other physical processes.

Short-Term Effectiveness: This alternative presents minimal increased short-term potential risks to workers involved in the groundwater monitoring program. The use of proper health and safety procedures during groundwater monitoring will minimize potential health risks. There will be no additional short-term environmental impacts.

Implementability: This alternative is easily implemented. Groundwater monitoring of existing wells and reporting are easily implemented. Implementing aquifer use restrictions involves standard procedures. The availability of services, materials, and/or technologies is not applicable to this alternative.

Cost: Estimated capital and O&M costs for GW RAA 2 are presented on Table 5-11. The estimated total net present worth cost for GW RAA 2 is $67,300.

5.5 Comparative Analysis of Groundwater Alternatives

This section presents a comparative analysis of the two Groundwater RAAs presented for Site 84. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each RAA. The seven previously introduced criteria used for the detailed analysis will be the basis for the following comparative analysis.

5.5.1 Overall Protection of Human Health and the Environment

Shallow groundwater poses an unacceptable risk for future adult and child residents or other receptors that may use the shallow aquifer for potable purposes. However, it is highly unlikely that use of the shallow groundwater as a potable source will occur at this site. Nonetheless, GW RAA 2 is more protective of human health than GW RAA 1 because it does include a provision for aquifer use restrictions. Neither alternative includes active remediation of groundwater, thus both alternatives are equal in protectiveness of the environment.

5.5.2 Compliance with ARARs

Neither alternative includes an active effort to reduce contaminant levels to below federal and state chemical-specific ARARs. However, under GW RAA 2, a groundwater monitoring program will confirm or refute the presence of pesticides above chemical-specific ARARs and will determine whether metals detected above chemical-specific ARARs are representative of background conditions.

5.5.3 Long-Term Effectiveness and Permanence

The no action alternative may not be effective over the long term in protecting human health if the shallow aquifer is used as a potable water supply in the future. GW RAA 2 is more protective of human health over the long term than GW RAA 1 because it does include aquifer use restrictions.

5.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Neither alternative will reduce the toxicity, mobility, or volume of contaminated groundwater at the site through treatment. However, contaminant concentrations may decrease over time through dispersion and other physical processes under both alternatives.

5.5.5 Short-Term Effectiveness

GW RAA 1 presents no increased short-term potential risks to workers or the community. GW RAA 2 presents minimal increased short-term potential risks to workers involved in groundwater monitoring, but these risks can be managed by using proper health and safety procedures.

5.5.6 Implementability

Both alternatives are easily implemented. Groundwater monitoring of existing wells and reporting are easily implemented. Implementing aquifer use restrictions involves standard procedures. Although aquifer use restrictions are easily implemented, enforcement of such controls over the long term can be an issue.

5.5.7 Cost

Estimated capital and O&M costs for GW RAA 2 are presented on Table 5-11. The estimated total net present worth cost for each GW RAA is provided below.

RAA #	RAA Name	RAA Cost
GW RAA 1	No Action	$0
GW RAA 2	Groundwater Monitoring and Institutional Controls	$67,300

6.0 REFERENCES

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TABLES

TABLE ES-1
SOIL REMEDIAL ACTION ALTERNATIVE SUMMARY TABLE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Remedial Action Alternative	Description / Components	Appropriate Land Uses	Land Use Controls Needed	TPH Cleanup Level	PCB Cleanup Level	PAH/Pesticide Cleanup Level	Usable Land Area	Remedial Action Alternative Cost
RAA 1) No Action	No remedial action or institutional controls	None	None	NA	NA	NA	8.5 acres	$0
High-Occupancy Land Uses								
RAA 2) Excavation and Landfill Disposal ("No Access Restrictions")	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration	Housing, school, park, marina, office building	None	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	1 ppm	Residential PRGs	9.8 acres	$1,311,100
RAA 2a) Excavation and Landfill Disposal ("Access Restrictions")	Excavate all soils above cleanup levels in open areas; fencc wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration	Housing, school, park, marina, office building	Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	1 ppm	Residential PRGs	8.5 acres	$1,012,700
RAA 3) Excavation and Capping ("No Access Restrictions")	Excavate all soils above 10 ppm PCBs; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding residential PRGs, TPH clcanup levels, or 1 ppm PCBs; site restoration; wetland restoration	Housing, school, park, marina, office building	Intrusive restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	10 ppm (excavation) 1 ppm (capping)	Residential PRGs (capping)	9.8 acres	$1,025,800
RAA 3a) Excavation and Capping ("Access Restrictions")	Excavate all soils above 10 ppm PCBs in open areas; fence wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding residential PRGs; TPH cleanup levels, and exceeding 1 ppm PCBs; site restoration	Housing, school, park, marina, office building	Intrusive restrictions, Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	10 ppm (excavation) 1 ppm (capping)	Residential PRGs (capping)	8.5 acres	$862,400
Low-Occupancy Land Uses								
RAA 4) Excavation and Landfill Disposal	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions, Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	10 ppm	Residential PRGs	9.8 acres	$820,600
RAA 5) Hot Spot Removal and Institutional Controls	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions, Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	25 ppm	Industrial PRGs	9.8 acres	$786,000
RAA 6) Hot Spot Removal and Fencing	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions, Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	50 ppm	Industrial PRGs	9.8 acres	$540,200
RAA 7) Hot Spot Removal and Capping	Excavate all soils above 100 ppm PCBs; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding industrial PRGs, TPH cleanup levels, or 25 ppm PCBs; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions, Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	100 ppm (excavation) 25 ppm (capping)	Industrial PRGs (capping)	9.8 acres	$517,800
Recreational Land Uses								
RAA 8) Excavation and Landfill Disposal ("No Access Restrictions")	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration	Marina, fishing, boating, community park	Land Use Restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	7.7 ppm	Risk-based goals (see Table 2-14)	9.8 acres	$1,181,100
RAA 8a) Excavation and Landfill Disposal ("Access Restrictions")	Excavate all soils above cleanup levels in open areas; fence wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration	Marina, fishing, boating, community park	Land Use Restrictions, Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	7.7 ppm	Risk-based goals (see Table 2-14)	8.5 acres	$996,900

TABLE ES-2
GROUNDWATER REMEDIAL ACTION ALTERNATIVE SUMMARY TABLE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Remedial Action Alternative	Description / Components	Land Use Controls Needed	Remedial Action Alternative Cost
GW-RAA 1) No Action	No remedial action or institutional controls	None	$0
GW-RAA 2) Groundwater Monitoring and Institutional Controls	Groundwater monitoring of representative site monitoring wells to evaluate metals/pesticides constituents. Implementation of aquifer use restrictions.	Aquifer use restrictions Intrusive Restrictions	$67,300

TABLE 2-1
NORTH CAROLINA CHEMICAL-SPECIFIC ARARS, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJUENE, NORTH CAROLINA

Potential State ARAR	Citation	Comment
Oil Pollution and Hazardous Substances Control Act	NCGS 143-215.75 et seq.	Protects the land and waters of NC from pollution
NC Water Quality Standards and Surface Water Effluent Limitations	15A NCAC 2B	Establishes a series of classifications and water quality standards for surface waters and limits effluent discharged to surface water.
NC Groundwater Standards	15A NCAC 2L	Establishes allowable levels of organic and inorganic compounds in groundwater
NC Air Pollution Control Regulations	15A NCAC 2D, 2H, 2Q	Regulates ambient air quality and establishes air quality standards for hazardous air pollutants.
NC Hazardous Waste Management Rules	15A NCAC 13A .0009 & .0012	Establishes standards for hazardous waste that is excavated and stored or treated as part of Remedial Action.
NC Underground Storage Tank Program	15A NCAC 2L.0115	Establishes standards for cleanup of TPH-contaminated soil.

TABLE 2-1a
FEDERAL CHEMICAL-SPECIFIC ARARS, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJUENE, NORTH CAROLINA

Potential Federal ARAR	Citation	Comment
Safe Drinking Water Act (SDWA)	40 CFR 141	Establishes federal Maximum Contaminant Levels (MCLs) for public water supplies.
Toxic Substances Control Act (TSCA)	40 CFR 761	Established recommended cleanup levels for PCBs in soil for low-occupancy and high-occupancy land uses.
USEPA guidance for PCB contamination	OSWER Directive No. 9355.4-01	USEPA guidance for recommended cleanup levels of PCBs in soil for various land uses.
USEPA Region IX Preliminary Remediation Goals (PRGs)	NA	Guidance on risk-based cleanup goals for residential and industrial land use scenarios.

TABLE 2-2
NORTH CAROLINA LOCATION-SPECIFIC ARARs, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJUENE, NORTH CAROLINA

Potential State ARAR	Citation	Comment
NC Hazardous Waste Management Rules	15A NCAC 13A	Location requirements and land disposal restrictions for hazardous waste excavated, stored, and/or treated onsite.
NC Solid Waste Management Rules	15A NCAC 13B .1600	Siting requirements for solid waste landfill facilities
NC Recordation of Inactive Hazardous Substance or Waste Disposal Sites	NCGS 130A-310.8	State requirement for recordation of inactive hazardous waste sites
NC Coastal Management	15A NCAC 7H	Guidelines for areas of environmental concern.

TABLE 2-2a
FEDERAL LOCATION-SPECIFIC ARARs, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Potential Federal ARAR	General Citation	ARAR Evaluation
National Historic Preservation Act of 1966 - requires action to take into account effects on properties included in or eligible for the National Register of Historic Places and to minimize harm to National Historic Landmarks.	16 USC 470, 40 CFR 6.301(b), and 36 CFR 800	No known historic properties are within or near Site 84, therefore, this act will not be considered an ARAR.
Archeological and Historic Preservation Act - establishes procedures to provide for preservation of historical and archeological data which might be destroyed through alteration of terrain.	16 USC 469, and 40 CFR 6.301(c)	No known historical or archeological data is known to be present at Site 84, therefore, this act will not be considered an ARAR.
Historic Sites, Buildings and Antiquities Act ~ requires action to avoid undesirable impacts on landmarks on the National Registry of Natural Landmarks.	16 USC 461467, and 40 CFR 6.301(a)	No known historic sites, buildings or antiquities are within or near Site 84, therefore, this act will not be considered as an ARAR.
Fish and Wildlife Coordination Act ~ requires action to protect fish and wildlife from actions modifying streams or areas affecting streams.	16 USC 661~666	Northeast Creek is located near and within the operable unit boundaries. If remedial actions are implemented that modify this creek, this will be an applicable ARAR.
Federal Endangered Species Act ~ requires action to avoid jeopardizing the continued existence of listed endangered species or modification of their habitat.	16 USC 1531, 50 CFR 200, and 50 CFR 402	Many protected species have been sited near and on MCB Camp Lejeune such as the American alligator, the Bachmans sparrow, the Black skimmer, the Green turtle, the Loggerhead turtle, the piping plover, the Red~cockaded woodpecker, and the rough~leaf loosestrife (LeBlond, 1991), (Fussell, 1991), Walters, 1991). Therefore, this will be considered an ARAR.
Rivers and Harbors Act of 1899 (Section 10 Permit) ~ requires permit for structures or work in or affecting navigable waters.	33 USC 403	No remedial actions will affect the navigable waters of Northeast Creek. Therefore, this act will not be considered an ARAR.
Executive Order 11990 on Protection of Wetlands - establishes special requirements for federal agencies to avoid the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	Executive Order Number 11990, and 40 CFR 6	Based on a review of Wetland Inventory Maps, Site 84 has wetland areas along Northeast Creek. Therefore, this will be an applicable ARAR.
Executive Order 11988 on Floodplain Management ~ establishes special requirements for federal agencies to evaluate the adverse impacts associated with direct and indirect development of a floodplain.	Executive Order Number 11988, and 40 CFR 6	Most of Site 84 is located outside the 500~year floodplain. However, the immediate areas around Northeast Creek are within the 100~year floodplain. Therefore, this may be an ARAR for the operable unit.

TABLE 2-2a (Continued)
FEDERAL LOCATION-SPECIFIC ARARs, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Potential Federal ARAR	General Citation	ARAR Evaluation
Wilderness Act ~ requires that federally owned wilderness areas are not impacted. Establishes nondegradation, maximum restoration, and protection of wilderness areas as primary management principles.	16 USC 1131, and 50 CFR 35.	No known federally-owned wilderness areas are located near Site 84, therefore, this act will not be considered an ARAR.
National Wildlife Refuge System ~ restricts activities within a National Wildlife Refuge.	16 USC 668, and 50 CFR 27	No known National Wildlife Refuge areas are located near Site 84, therefore, this will not be considered an ARAR.
Scenic Rivers Act ~ requires action to avoid adverse effects on designated wild or scenic rivers.	16 USC 1271, and 40 CFR 6.302(e)	No known wild or scenic rivers are located near Site 84, therefore, this act will not be considered an ARAR.
Coastal Zone Management Act ~ requires activities affecting land or water uses in a coastal zone to certify noninterference with coastal zone management.	16 USC 1451	No activities at the site will affect land or water uses in a coastal zone, therefore, this act will not be considered an ARAR.
Clean Water Act (Section 404) ~ prohibits discharge of dredged or fill material into wetland without a permit.	33 USC 404	No actions to discharge dredged or fill material into wetlands will be considered for Site 84, therefore, this act will not be considered an ARAR.
RCRA Location Requirements ~ limitations on where on-site storage, treatment, or disposal of RCRA hazardous waste may occur.	40 CFR 264.18	These requirements may be applicable if the remedial actions for Site 84 include the on-site storage, treatment, or disposal of RCRA hazardous waste. No RCRA hazardous waste is expected to be present at Site 84, therefore, these requirements are not considered an ARAR.

Notes:

LeBlond, Richard. 1991. "Critical Species List. Camp Lejeune. Endangered Species and Special-Interest Communities Survey". Principal Investigator.

TABLE 2-3
NORTH CAROLINA ACTION-SPECIFIC ARARS, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJUENE, NORTH CAROLINA

Potential State ARAR	Citation	Comment
NC Groundwater Corrective Action	15A NCAC 2L .0106	Regulations for cleanup of contaminated groundwater.
NC Well Construction Standards	15A NCAC 2C .0100	Construction and abandonment requirements for water wells.
NC Injection Well Construction Standards	15A NCAC 2C .0200	Construction requirements for injection wells.
NC Water Quality Discharge Requirements	15A NCAC 2H .0100 & .0200	Waste water requirements for discharges and infiltration galleries.
NC Sedimentation Control Rules	15A NCAC 4B	Requirements for storm water management and erosion control
NC Hazardous Waste Management Rules	15A NCAC 13A	Design and treatment requirements for hazardous waste
NC Solid Waste Management Rules	15A NCAC 13B	Design and monitoring requirements for solid waste disposal sites
NC Air Pollution Control Requirements	15A NCAC 2D, 2H .0600, 2Q	Regulates air quality and establishes emissions standards.

TABLE 2-3a
FEDERAL ACTION-SPECIFIC ARARs, CRITERIA, AND GUIDANCE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Standard [1]	Action	General Citation
RCRA	Capping	40 CFR 264
	Closure	40 CFR 264, 244
	Container Storage	40 CFR 264, 268
	New Landfill	40 CFR 264
	New Surface Impoundment	40 CFR 264
	Dike Stabilization	40 CFR 264
	Excavation, Groundwater Diversion	40 CFR 264, 268
	Incineration	40 CFR 264, 761
	Land Treatment	40 CFR 264
	Land Disposal	40 CFR 264, 268
	Slurry Wall	40 CFR 264, 268
	Tank Storage	40 CFR 264, 268
	Treatment	40 CFR 264, 265, 268; 42 USC 6924; 51 FR 40641; 52 FR 25760
	Waste Pile	40 CFR 264, 268
CWA	Discharge to Water of United States	40 CFR 122, 125, 136
	Direct Discharge to Ocean	40 CFR 125
	Discharge to POTW	40 CFR 403, 270
	Dredge/Fill	40 CFR 264; 33 CFR 320-330; 33 USC 403
CAA (NAAQS)	Discharge to Air	40 CFR 50
SDWA	Underground Injection Control	40 CFR 144, 146, 147, 268
TSCA	PCB Storage/Disposal Regulations	40 CFR 750, 761
DOT	DOT Rules for Transportation	49 CFR 107

Notes:

[1] RCRA = Resource Conservation Recovery Act
CWA = Clean Water Act
CAA = Clean Air Act
NAAQS = National Ambient Air Quality Standards
SDWA = Safe Drinking Water Act
TSCA = Toxic Substances Control Act
DOT = Department of Transportation

TABLE 2-4
SURFACE SOIL DATA AND COC SELECTION SUMMARY (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Residential Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
2-Butanone	7,300,000 N	2/26	4.8 J - 9 J	IR84-MW20-00	No	PRG
Acetone	1,600,000 N	1/26	40 J - 40 J	84-MW15-00	No	PRG
Ethylbenzene	230,000 S	1/26	330 J - 330 J	IR84-DP82-00	No	PRG
Xylenes (total)	210,000 S	2/26	8.7 J - 120 J	IR84-DP82-00	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	3/26	120 J - 92,000	IR84-DP84-00	No	Region III
Acenaphthene	3,700,000 N	8/26	140 J - 20,000 J	IR84-DP46-00	No	PRG
Anthracene	22,000,000 N	8/26	210 J - 56,000	IR84-DP46-00	No	PRG
Benzo(a)anthracene	620 C	8/26	520 - 190,000	IR84-DP46-00	Yes	PRG
Benzo(a)pyrene	62 C	7/26	470 - 150,000	IR84-DP46-00	Yes	PRG
Benzo(b)fluoranthene	620 C	7/26	540 - 170,000	IR84-DP46-00	Yes	PRG
Benzo(ghi)perylene	6,720,000 N [3]	9/26	74 J - 55,000	IR84-DP46-00	No	PRG
Benzo(k)fluoranthene	6,200 C	7/26	340 J - 120,000	IR84-DP46-00	Yes	PRG
Carbazole	24,000 C	7/26	130 J - 38,000 J	IR84-DP46-00	Yes	PRG
Chrysene	62,000 C	8/26	560 - 180,000	IR84-DP46-00	Yes	PRG
Dibenz(a,h)anthracene	62 C	7/26	70 J - 17,000 J	IR84-DP46-00	Yes	PRG
Dibenzofuran	290,000 N	7/26	84 J - 8,900 J	IR84-DP46-00	No	PRG
Fluoranthene	2,300,000 N	8/26	1,200 - 300,000	IR84-DP46-00	No	PRG
Fluorene	2,600,000 C	9/26	130 J - 19,000 J	IR84-DP46-00	No	PRG
Hexachlorocyclopentadiene	420,000 N	1/26	410 J - 410 J	IR84-DP47-00	No	PRG
Indeno(1,2,3-cd)pyrene	620 N	7/26	250 J - 59,000	IR84-DP46-00	Yes	PRG
Naphthalene	56,000 N	5/26	140 J - 7,500 J	IR84-DP46-00	No	PRG
Phenanthrene	59,600 [3]	9/26	910 J - 180,000	IR84-DP46-00	Yes	PRG
Pyrene	2,300,000 N	8/26	760 - 250,000	IR84-DP46-00	No	PRG
bis(2-Ethylhexyl) phthalate	35,000 C	2/26	140 J - 620	IR84-MW20-00D	No	PRG
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	2,400 C	7/24	3.2 J - 3,000 J	IR84-DP47-00	Yes	PRG
4,4'-DDE	1,700 C	7/24	3.1 - 58	IR84-DP49-00	No	PRG
4,4'-DDT	1,700 C	7/24	1.9 - 190	IR84-DP49-00	No	PRG
Dieldrin	30 C	8/24	3.5 J - 320	IR84-DP49-00	Yes	PRG
Endosulfan sulfate	370,000 N [4]	6/25	2.1 J - 54 J	IR84-MW20-00	No	PRG
Endrin	18,000 N	1/24	6.9 J - 6.9 J	IR84-MW20-00	No	PRG
Endrin aldehyde	18,000 N [5]	8/25	4.5 J - 74 J	IR84-MW20-00	No	PRG
Endrin ketone	18,000 N [5]	5/25	1.7 J - 26 J	IR84-DP81-00	No	PRG
Heptachlor	110 C	8/24	1.5 J - 22,000	IR84-DP47-00	Yes	PRG
Heptachlor epoxide	53 C	6/24	4.2 J - 4,500 J	IR84-DP47-00	Yes	PRG
Methoxychlor	310,000 N	7/25	1.9 J - 98 J	IR84-MW20-00	No	PRG
Aroclor-1248	1,000 C [6]	4/95	56 - 160,000	IR84-DP47-00	Yes	TSCA
Aroclor-1254	1,000 C [6]	1/95	51,000 - 51,000	IR84-DP53-00	Yes	TSCA
Aroclor-1260	1,000 C [6]	68/95	18 J - 200,000	IR84-SB27-01	Yes	TSCA
PCB-Ensys Test Kit Results	1,000 C [6]	33/60	1,000 - >50,000	IR84-DP32, IR84-DP64	Yes	TSCA
alpha-BHC	90 C	1/24	21 - 21	IR84-DP82-00	No	PRG
alpha-Chlordane	1,600 C [7]	10/24	2 J - 48,000 J	IR84-DP47-00	Yes	PRG
gamma-Chlordane	1,600 C [7]	10/24	3.9 - 58,000	IR84-DP47-00	Yes	PRG

TABLE 2-4 (continued)
SURFACE SOIL DATA AND COC SELECTION SUMMARY (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Residential Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
TOTAL PETROLEUM HYDROCARBONS (ug/kg)						
TPH (as Diesel)	10,000 [8]	11/11	7,000 J - 470,000	IR84-DP46-00	Yes	UST
TPH (as Gasoline)	40,000 [8]	1/11	880 - 880	IR84-DP46-00	No	UST
METALS (mg/kg)						
Aluminum	76,000 N	26/26	1,270 - 8,940	IR84-MW20-00	No	PRG
Antimony	31 N	13/26	0.66 J - 3.3 J	IR84-DP49-00	No	PRG
Arsenic	26.2 C [3]	24/26	0.33 J - 9.1	IR84-DP49-00	No	SSL
Barium	5,400 N	23/26	3 J - 65.7	IR84-DP49-00	No	PRG
Beryllium	150 N	5/26	0.06 J - 0.075 J	IR84-DP46-00	No	PRG
Cadmium	37 N	14/26	0.067 J - 0.57	IR84-DP53-00	No	PRG
Calcium	NE	26/26	109 J - 100,000 J	IR84-DP50-00	No	NA
Chromium	210 N	26/26	1.7 - 20.2	IR84-DP49-00	No	PRG
Cobalt	4,700 N	23/26	0.18 J - 0.76 J	IR84-DP49-00	No	PRG
Copper	2,900 N	26/26	0.35 J - 146	IR84-DP49-00	No	PRG
Iron	23,000 N	26/26	684 - 5,000	IR84-MW20-00	No	PRG
Lead	400 N [9]	26/26	1.8 - 97.3	IR84-DP49-00	No	EPA
Magnesium	NE	26/26	47.3 J - 1,480	IR84-DP49-00	No	NA
Manganese	1,800 N	26/26	2.7 - 32.8	IR84-DP49-00	No	PRG
Mercury	23,000 N	18/26	0.01 J - 0.2	IR84-DP74-00	No	PRG
Nickel	1,600 N	26/26	0.46 J - 2.9 J	IR84-DP49-00	No	PRG
Potassium	NE	17/26	70.2 J - 258 J	IR84-DP76-00	No	NA
Selenium	390 N	2/26	0.53 J - 0.61	IR84-DP74-00	No	PRG
Sodium	NE	3/26	165 J - 235 J	IR84-DP50-00	No	NA
Thallium	5.5 [2]	1/26	0.6 J - 0.6 J	IR84-DP45-00	No	Region III
Vanadium	550 N	26/26	2.3 J - 11.2	IR84-MW20-00	No	PRG
Zinc	23,000 N	26/26	1.3 J - 154 J	IR84-DP49-00	No	PRG

Notes:

C - Carcinogenic
N - Non-Carcinogenic
S - Soil Saturation
NA - Not Applicable
NE - Not Established
PRG - Preliminary Remediation Goal
COC - Chemical of Concern
TSCA-Toxic Substances Control Act
SSL - Soil Screening Level
UST - North Carolina Underground Storage Tank Program
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram

J - Analyte present - Reported value is estimated

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Residential Preliminary Remediation Goals
(2) USEPA Region III Residential RBC
(3) North Carolina Soil-to-Groundwater Concentration
(4) Screening value for endosulfan used as a surrogate
(5) Screening value for endrin used as a surrogate
(6) Residential Cleanup Goal under TSCA for PCBs
(7) Screening value for chlordane used as a surrogate
(8) TPH Cleanup goal for low boiling point fuels (gasolene range) under North Carolina UST Regulations
(9) EPA action level for lead

TABLE 2-5
SUBSURFACE SOIL DATA AND COC SELECTION SUMMARY (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0129
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Residential Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
1,2-Dichloroethene (total)	63,000 N	1/24	91 J - 91 J	IR84-DP82-04	No	PRG
2-Butanone	7,300,000 N	1/24	3.8 J - 3.8 J	IR84-MW21-04	No	PRG
Acetone	1,600,000 N	2/24	14 J - 18 J	IR84-MW21-04	No	PRG
Benzene	670 C	2/24	120 J - 160 J	84-MW15-04	No	PRG
Chloroform	240 C	3/24	0.98 J - 2.3 J	IR84-SB05-01	No	PRG
Ethylbenzene	230,000 N	5/24	0.89 J - 1,300	IR84-DP75-05	No	PRG
Methylene chloride	8,900 C	1/24	1.3 J - 1.3 J	IR84-DP78-03	No	PRG
Styrene	1,700,000 N	1/24	2.1 J - 2.1 J	IR84-MW23-01	No	PRG
Toluene	520,000 N	1/24	75 J - 75 J	IR84-DP75-05	No	PRG
Xylenes (total)	210,000 N	4/24	4.1 J - 3,100	IR84-DP75-05	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	3/33	1,000 - 27,000	84-MW15-04	No	Region III
Acenaphthene	3,700,000 N	4/33	61 J - 950 J	IR84-DP15-03	No	PRG
Anthracene	22,000,000 N	3/33	190 J - 830 J	IR84-DP46-02	No	PRG
Benzo(a)anthracene	620 C	3/33	640 - 3,000	IR84-DP46-02	Yes	PRG
Benzo(a)pyrene	62 C	3/33	590 - 2,600	IR84-DP46-02	Yes	PRG
Benzo(b)fluoranthene	620 C	5/33	68 J - 2,800	IR84-DP46-02	Yes	PRG
Benzo(ghi)perylene	6,720,000 C [8]	5/33	65 J - 1,200	IR84-DP46-02	No	PRG
Benzo(k)fluoranthene	6,200 C	3/33	280 J - 1,700	IR84-DP46-02	No	PRG
Carbazole	24,000 N	3/33	110 J - 480 J	IR84-DP46-02	No	PRG
Chrysene	62,000 C	5/33	57 J - 3,100	IR84-DP46-02	No	PRG
Dibenz(a,h)anthracene	62 C	3/33	98 J - 430 J	IR84-DP46-02	Yes	PRG
Dibenzofuran	290,000 N	3/33	160 J - 1,300 J	IR84-DP15-03	No	PRG
Fluoranthene	2,300,000 N	5/33	74 J - 4,800	IR84-DP46-02	No	PRG
Fluorene	2,600,000 N	5/33	61 J - 1,500 J	IR84-DP15-03	No	PRG
Hexachlorocyclopentadiene	420,000 N	1/33	94 J - 94 J	IR84-DP47-01	No	PRG
Indeno(1,2,3-cd)pyrene	620 C	3/33	340 J - 1,200	IR84-DP46-02	Yes	PRG
Naphthalene	56,000 N	4/33	55 J - 8,500	84-MW15-04	No	PRG
Phenanthrene	59,600 N [8]	6/33	150 J - 3,400 J	84-MW15-04,IR84-DP15-03	No	PRG
Phthalic anhydride	100,000 N	2/2	120 NJ - 170 NJ	IR84-SB04-02	No	PRG
Pyrene	2,300,000 N	5/33	69 J - 4,100	IR84-DP46-02	No	PRG
bis(2-Chloroethoxy)methane	NE	1/33	54 - 54	IR84-DP81-04	No	NA
bis(2-Ethylhexyl) phthalate	35,000 N	7/33	91 J - 1,800	IR84-MW22-02	No	PRG
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	2,400 C	7/33	1.7 J - 46 J	IR84-DP45-03	No	PRG
4,4'-DDE	1,700 C	5/33	2 J - 16	IR84-DP52-01	No	PRG
4,4'-DDT	1,700 C	5/33	2.5 - 120 J	IR84-DP52-01	No	PRG
alpha-Chlordane	1,600 C [3]	8/33	3.3 J - 14,000 J	IR84-DP47-01	Yes	PRG
beta-BHC	320 C	1/33	1.7 J - 1.7 J	84-MW17-07	No	PRG
Dieldrin	30 C	3/33	1.8 - 2.4	IR84-SB01-02	No	PRG
Endrin aldehyde	18,000 N [4]	1/33	10 J - 10 J	IR84-DP15-03	No	PRG
gamma-Chlordane	1,600 N [3]	8/33	3.3 J - 18,000	IR84-DP47-01	Yes	PRG
Heptachlor epoxide	53 C	2/33	63 J - 200 J	IR84-DP46-02	Yes	PRG
Heptachlor	110 C	7/33	1.6 J - 6,900	IR84-DP47-01	Yes	PRG
Methoxychlor	310,000 N	3/33	2.9 J - 24 J	IR84-DP15-03	No	PRG
Aroclor-1248	1,000 N [5]	1/39	47,000 - 47,000	IR84-DP47-01	Yes	TSCA
Aroclor-1254	1,000 N [5]	1/39	5,000 - 5,000	IR84-DP46-02	Yes	TSCA
Aroclor-1260	1,000 N [5]	11/39	13 J - 45,000	IR84-DP18-02	Yes	TSCA
PCB-Ensys Test Kit Results	1,000 N [5]	4/5	1,000 - > 50,000	IR84-DP18-02	Yes	TSCA

TABLE 2-5 (continued)
SUBSURFACE SOIL DATA AND COC SELECTION SUMMARY (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0129
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Residential Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
TOTAL PETROLEUM HYDROCARBONS (ug/kg)						
TPH (as Diesel)	10,000 [6]	8/8	15,000 - 5,500,000	IR84-DP15-03	Yes	UST
TPH (as Gasoline)	40,000 [6]	2/8	220 - 580,000	IR84-DP15-03	Yes	UST
METALS (mg/kg)						
Aluminum	76,000 N	33/33	589 - 7,210	IR84-DP77-03	No	PRG
Antimony	31 N	8/33	0.6 J - 1.3 B	IR84-DP15-03	No	PRG
Arsenic	26.2 C [7]	29/33	0.33 J - 2	IR84-DP15-03,IR84-DP79-02D	No	PRG
Barium	5,400 N	21/33	0.92 J - 24.3	IR84-DP49-01	No	PRG
Beryllium	150 N	5/33	0.051 J - 0.13 B	IR84-DP15-03	No	PRG
Cadmium	37 N	7/33	0.05 J - 0.18 J	IR84-DP49-01	No	PRG
Calcium	NE	33/33	71.4 J - 66,800 J	IR84-SB03-02	No	NA
Chromium	210 N	33/33	1.2 - 9.9	IR84-DP45-03	No	PRG
Cobalt	4,700 N	27/33	0.16 J - 0.69 J	IR84-DP52-01	No	PRG
Copper	2,900 N	29/33	0.34 J - 25.5	IR84-DP50-01	No	PRG
Iron	23,000 N	33/33	155 - 6,140	IR84-DP15-03	No	PRG
Lead	400 N [8]	33/33	0.87 - 52.7	IR84-DP49-01	No	EPA
Magnesium	NE	33/33	16.4 J - 943	IR84-SB03-02	No	NA
Manganese	1,800 N	33/33	0.48 J - 50.5	IR84-SB03-02	No	PRG
Mercury	23,000 N	23/33	0.0092 J - 0.055 J	IR84-DP46-02	No	PRG
Nickel	1,600 N	32/33	0.42 J - 3.5 J	IR84-DP50-01	No	PRG
Potassium	NE	27/33	21.3 J - 195 J	IR84-DP77-03	No	NA
Selenium	390 N	8/33	0.39 J - 0.73	IR84-SB03-02	No	PRG
Sodium	NE	1/33	89.7 J - 89.7 J	IR84-SB03-02	No	NA
Thallium	5.5 [2]	5/33	0.64 J - 0.9 J	IR84-SB03-02	No	Region III
Vanadium	550 N	33/33	1.1 J - 11.4	IR84-DP79-02D	No	PRG
Zinc	23,000 N	29/33	1.4 J - 42.6 J	IR84-DP49-01	No	PRG

Notes:

C - Carcinogenic
N - Non-Carcinogenic
S - Soil Saturation
NA - Not Applicable
NE - Not Established

PRG - Preliminary Remediation Goal
COC - Chemical of Concern
TSCA-Toxic Substances Control Act
RBC - Region III Risk-Based Concentration
UCL - Upper Confidence Limit

ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
UST - North Carolina Underground Storage Tank Program

J - Analyte present - Reported value is estimated

B = value is less than contract required detection limit but greater than instrument detection limit

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Residential Preliminary Remediation Goals
(2) USEPA Region III Residential RBC
(3) Screening value for chlordane used as a surrogate
(4) Screening value for endrin used as a surrogate
(5) Residential Cleanup Goal under TSCA for PCBs
(6) TPH Cleanup goal for low boiling point fuels (gasolene range) under North Carolina UST Regulations
(7) North Carolina Soil-to-Groundwater Concentration
(8) EPA action level for lead

TABLE 2-6
LAGOON SEDIMENT DATA AND COC SELECTION SUMMARY (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COPC Selection	
	Residential Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COPC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
Xylenes (total)	210,000 S	1/1	910 J	IR84-SD07-98B	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	1/1	10,000	IR84-SD07-98B	No	Region III
Naphthalene	56,000 N	1/1	2,000	IR84-SD07-98B	No	PRG
Phenanthrene	59,600 N [2]	1/1	2,500	IR84-SD07-98B	No	PRG
bis(2-Ethylhexyl) phthalate	35,000 C	1/1	2,400 J	IR84-SD07-98B	No	PRG
PCBs (ug/kg)						
Aroclor-1248	1,000 C [3]	1/7	2,800	84-SD05-01	Yes	TSCA
Aroclor-1260	1,000 C [3]	7/7	3,700 - 40,000	IR84-SD01-98B	Yes	TSCA
TOTAL PETROLEUM HYDROCARBONS (ug/kg)						
Diesel Range Organics	40,000 [4]	4/4	3,500 - 14,000	IR84-SD01-98BD	No	UST

Notes:

C - Carcinogenic
N - Non-Carcinogenic
S - Soil Saturation
NE - Not Established
PRG - Preliminary Remediation Goal
COC - Chemical of Concern
TSCA-Toxic Substances Control Act
UCL - Upper Confidence Limit
ug/kg - microgram per kilogram
UST - North Carolina Underground Storage Tank Program

J - Analyte present - Reported value is estimated

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Residential Preliminary Remediation Goals
(2) USEPA Region III Residential RBC
(3) Residential Cleanup Goal under TSCA for PCBs
(4) TPH Cleanup goal for low boiling point fuels (gasolene range) under North Carolina UST Regulations

TABLE 2-7
FINAL SOIL COCs AND REMEDIATION GOALS (HIGH-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Remedial Goal	Basis For Remedial Goal
4,4'-DDD	2,400 ug/kg	PRG
alpha-Chlordane	1,600 ug/kg (2)	PRG
Aroclor-1248	1 ppm (1)	TSCA
Aroclor-1254	1 ppm (1)	TSCA
Aroclor-1260	1 ppm (1)	TSCA
Benzo(a)anthracene	620 ug/kg	PRG
Benzo(a)pyrene	62 ug/kg	PRG
Benzo(b)fluoranthene	620 ug/kg	PRG
Benzo(k)fluoranthene	6,200 ug/kg	PRG
Carbazole	24,000 ug/kg	PRG
Chrysene	62,000 ug/kg	PRG
Dibenz(a,h)anthracene	62 ug/kg	PRG
Dieldrin	30 ug/kg	PRG
gamma-Chlordane	1,600 ug/kg (2)	PRG
Heptachlor	110 ug/kg	PRG
Heptachlor epoxide	53 ug/kg	PRG
Indeno(1,2,3-cd)pyrene	620 ug/kg	PRG
Phenanthrene	59,600 ug/kg (3)	PRG
TPH (Diesel Range Organics)	40,000 ug/kg	UST
TPH (Gasoline Range Organics)	10,000 ug/kg	UST

Notes:

PRG - EPA Region IX Preliminary Remediation Goal (Residential)
TSCA-Toxic Substances Control Act
UST - North Carolina Underground Storage Tank Program
ug/kg - microgram per kilogram
ppm - parts per million (same as milligram per kilogram)

(1) Remedial Goal for PCBs under TSCA may be 10 ppm if area is capped with a soil, concrete or asphalt cover
(2) Screening value for Chlordane
(3) North Carolina Soil to Groundwater Concentration

TABLE 2-8
SURFACE SOIL DATA AND COC SELECTION SUMMARY (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Industrial Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
2-Butanone	28,000,000 N	2/26	4.8 J - 9 J	IR84-MW20-00	No	PRG
Acetone	6,200,000 N	1/26	40 J - 40 J	84-MW15-00	No	PRG
Ethylbenzene	230,000 S	1/26	330 J - 330 J	IR84-DP82-00	No	PRG
Xylenes (total)	210,000 S	2/26	8.7 J - 120 J	IR84-DP82-00	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	3/26	120 J - 92,000	IR84-DP84-00	No	Region III
Acenaphthene	38,000,000 N	8/26	140 J - 20,000 J	IR84-DP46-00	No	PRG
Anthracene	390,000,000 N	8/26	210 J - 56,000	IR84-DP46-00	No	PRG
Benzo(a)anthracene	2,900 C	8/26	520 - 190,000	IR84-DP46-00	Yes	PRG
Benzo(a)pyrene	290 C	7/26	470 - 150,000	IR84-DP46-00	Yes	PRG
Benzo(b)fluoranthene	2,900 C	7/26	540 - 170,000	IR84-DP46-00	Yes	PRG
Benzo(ghi)perylene	6,720,000 N [3]	9/26	74 J - 55,000	IR84-DP46-00	No	RBC
Benzo(k)fluoranthene	29,000 C	7/26	340 J - 120,000	IR84-DP46-00	Yes	PRG
Carbazole	120,000 C	7/26	130 J - 38,000 J	IR84-DP46-00	No	PRG
Chrysene	290,000 C	8/26	560 - 180,000	IR84-DP46-00	No	PRG
Dibenz(a,h)anthracene	290 C	7/26	70 J - 17,000 J	IR84-DP46-00	Yes	PRG
Dibenzofuran	5,100,000 N	7/26	84 J - 8,900 J	IR84-DP46-00	No	PRG
Fluoranthene	30,000,000 N	8/26	1,200 - 300,000	IR84-DP46-00	No	PRG
Fluorene	33,000,000 N	9/26	130 J - 19,000 J	IR84-DP46-00	No	PRG
Hexachlorocyclopentadiene	5,900,000 N	1/26	410 J - 410 J	IR84-DP47-00	No	PRG
Indeno(1,2,3-cd)pyrene	2,900 C	7/26	250 J - 59,000	IR84-DP46-00	Yes	PRG
Naphthalene	190,000 N	5/26	140 J - 7,500 J	IR84-DP46-00	No	PRG
Phenanthrene	59,600 [3]	9/26	910 J - 180,000	IR84-DP46-00	Yes	PRG
Pyrene	54,000,000 N	8/26	760 - 250,000	IR84-DP46-00	No	PRG
bis(2-Ethylhexyl) phthalate	180,000 C	2/26	140 J - 620	IR84-MW20-00D	No	PRG
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	17,000 C	7/24	3.2 J - 3,000 J	IR84-DP47-00	No	PRG
4,4'-DDE	12,000 C	7/24	3.1 - 58	IR84-DP49-00	No	PRG
4,4'-DDT	12,000 C	7/24	1.9 - 190	IR84-DP49-00	No	PRG
Dieldrin	150 C	8/24	3.5 J - 320	IR84-DP49-00	Yes	PRG
Endosulfan sulfate	5,300,000 N [4]	6/25	2.1 J - 54 J	IR84-MW20-00	No	PRG
Endrin	260,000 N	1/24	6.9 J - 6.9 J	IR84-MW20-00	No	PRG
Endrin aldehyde	260,000 N [5]	8/25	4.5 J - 74 J	IR84-MW20-00	No	PRG
Endrin ketone	260,000 N [5]	5/25	1.7 J - 26 J	IR84-DP81-00	No	PRG
Heptachlor	550 C	8/24	1.5 J - 22,000	IR84-DP47-00	Yes	PRG
Heptachlor epoxide	270 C	6/24	4.2 J - 4,500 J	IR84-DP47-00	Yes	PRG
Methoxychlor	4,400,000 N	7/25	1.9 J - 98 J	IR84-MW20-00	No	PRG
Aroclor-1248	10,000 C [6]	4/95	56 - 160,000	IR84-DP47-00	Yes	EPA
Aroclor-1254	10,000 C [6]	1/95	51,000 - 51,000	IR84-DP53-00	Yes	EPA
Aroclor-1260	10,000 C [6]	68/95	18 J - 200,000	IR84-SB27-01	Yes	EPA
PCB-Ensys Test Kit Results	10,000 C [6]	33/60	1,000 - >50,000	IR84-DP32, IR84-DP64	Yes	EPA
alpha-BHC	590 C	1/24	21 - 21	IR84-DP82-00	No	PRG
alpha-Chlordane	11,000 C [7]	10/24	2 J - 48,000 J	IR84-DP47-00	Yes	PRG
gamma-Chlordane	11,000 C [7]	10/24	3.9 - 58,000	IR84-DP47-00	Yes	PRG

TABLE 2-8 (continued)
SURFACE SOIL DATA AND COC SELECTION SUMMARY (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location				COC Selection	
	Industrial Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections			Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
METALS (mg/kg)								
Aluminum	100,000 N	26/26	1270	-	8,940	IR84-MW20-00	No	PRG
Antimony	820 N	13/26	0.66 J	-	3.3 J	IR84-DP49-00	No	PRG
Arsenic	26.2 C [3]	24/26	0.33 J	-	9.1	IR84-DP49-00	No	PRG
Barium	100,000 N	23/26	3 J	-	65.7	IR84-DP49-00	No	PRG
Beryllium	2,200 N	5/26	0.06 J	-	0.075 J	IR84-DP46-00	No	PRG
Cadmium	810 N	14/26	0.067 J	-	0.57	IR84-DP53-00	No	PRG
Calcium	NE	26/26	109 J	-	100,000 J	IR84-DP50-00	No	NA
Chromium	450 N	26/26	1.7	-	20.2	IR84-DP49-00	No	PRG
Cobalt	100,000 N	23/26	0.18 J	-	0.76 J	IR84-DP49-00	No	PRG
Copper	76,000 N	26/26	0.35 J	-	146	IR84-DP49-00	No	PRG
Iron	100,000 N	26/26	684	-	5,000	IR84-MW20-00	No	PRG
Lead	400 N [8]	26/26	1.8	-	97.3	IR84-DP49-00	No	EPA
Magnesium	NE	26/26	47.3 J	-	1,480	IR84-DP49-00	No	NA
Manganese	32,000 N	26/26	2.7	-	32.8	IR84-DP49-00	No	PRG
Mercury	610 N	18/26	0.01 J	-	0.2	IR84-DP74-00	No	PRG
Nickel	41,000 N	26/26	0.46 J	-	2.9 J	IR84-DP49-00	No	PRG
Potassium	NE	17/26	70.2 J	-	258 J	IR84-DP76-00	No	NA
Selenium	10,000 N	2/26	0.53 J	-	0.61	IR84-DP74-00	No	PRG
Sodium	NE	3/26	165 J	-	235 J	IR84-DP50-00	No	NA
Thallium	512 [3]	1/26	0.6 J	-	0.6 J	IR84-DP45-00	No	PRG
Vanadium	14,000 N	26/26	2.3 J	-	11.2	IR84-MW20-00	No	PRG
Zinc	100,000 N	26/26	1.3 J	-	154 J	IR84-DP49-00	No	PRG

Notes:

C - Carcinogenic
N - Non-Carcinogenic
S - Soil Saturation
NE - Not Established
NA - Not Applicable
PRG - Preliminary Remediation Goal
COC - Chemical of Concern
UCL - Upper Confidence Limit
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
EPA - OSWER directive for industrial land use

J - Analyte present - Reported value is estimated

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Industrial Preliminary Remediation Goals
(2) USEPA Region III Industrial RBC
(3) North Carolina Soil to Groundwater Concentration
(4) Screening value for endosulfan used as a surrogate
(5) Screening value for endrin used as a surrogate
(6) EPA OSWER directive for industrial land use. Low-occupancy remedial goals for PCBs under TSCA may be 25 ppm with no additional controls, 50 ppm if area is secured with fencing and 100 ppm if area is capped with a soil, concrete or asphalt cover
(7) Screening value for chlordane used as a surrogate
(8) EPA action level for lead

TABLE 2-9
SUBSURFACE SOIL DATA AND COC SELECTION SUMMARY (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Industrial Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
1,2-Dichloroethene (total)	210,000 N	1/24	91 J - 91 J	IR84-DP82-04	No	PRG
2-Butanone	28,000,000 N	1/24	3.8 J - 3.8 J	IR84-MW21-04	No	PRG
Acetone	6,200,000 N	2/24	14 J - 18 J	IR84-MW21-04	No	PRG
Benzene	1,500 C	2/24	120 J - 160 J	84-MW15-04	No	PRG
Chloroform	520 C	3/24	0.98 J - 2.3 J	IR84-SB05-01	No	PRG
Ethylbenzene	230,000 C	5/24	0.89 J - 1,300	IR84-DP75-05	No	PRG
Methylene chloride	21,000 C	1/24	1.3 J - 1.3 J	IR84-DP78-03	No	PRG
Styrene	1,700,000 N	1/24	2.1 J - 2.1 J	IR84-MW23-01	No	PRG
Toluene	520,000 N	1/24	75 J - 75 J	IR84-DP75-05	No	PRG
Xylenes (total)	210,000 N	4/24	4.1 J - 3,100	IR84-DP75-05	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	3/33	1,000 - 27,000	84-MW15-04	No	Region III
Acenaphthene	38,000,000 N	4/33	61 J - 950 J	IR84-DP15-03	No	PRG
Anthracene	390,000,000 N	3/33	190 J - 830 J	IR84-DP46-02	No	PRG
Benzo(a)anthracene	2,900 C	3/33	640 - 3,000	IR84-DP46-02	Yes	PRG
Benzo(a)pyrene	290 C	3/33	590 - 2,600	IR84-DP46-02	Yes	PRG
Benzo(b)fluoranthene	2,900 C	5/33	68 J - 2,800	IR84-DP46-02	No	PRG
Benzo(ghi)perylene	6,720,000 C [3]	5/33	65 J - 1,200	IR84-DP46-02	No	PRG
Benzo(k)fluoranthene	29,000 C	3/33	280 J - 1,700	IR84-DP46-02	No	PRG
Carbazole	120,000 C	3/33	110 J - 480 J	IR84-DP46-02	No	PRG
Chrysene	290,000 C	5/33	57 J - 3,100	IR84-DP46-02	No	PRG
Dibenz(a,h)anthracene	290 C	3/33	98 J - 430 J	IR84-DP46-02	Yes	PRG
Dibenzofuran	5,100,000 N	3/33	160 J - 1,300 J	IR84-DP15-03	No	PRG
Fluoranthene	30,000,000 N	5/33	74 J - 4,800	IR84-DP46-02	No	PRG
Fluorene	33,000,000 N	5/33	61 J - 1,500 J	IR84-DP15-03	No	PRG
Hexachlorocyclopentadiene	5,900,000 N	1/33	94 J - 94 J	IR84-DP47-01	No	PRG
Indeno(1,2,3-cd)pyrene	2,900 C	3/33	340 J - 1,200	IR84-DP46-02	No	PRG
Naphthalene	190,000 N	4/33	55 J - 8,500	84-MW15-04	No	PRG
Phenanthrene	59,600 N [3]	6/33	150 J - 3,400 J	84-MW15-04,IR84-DP15-03	No	PRG
Phthalic anhydride	100,000 N	2/2	120 NJ - 170 NJ	IR84-SB04-02	No	PRG
Pyrene	5,400,000 N	5/33	69 J - 4,100	IR84-DP46-02	No	PRG
bis(2-Chloroethoxy)methane	NE	1/33	54 - 54	IR84-DP81-04	No	NA
bis(2-Ethylhexyl) phthalate	180,000 C	7/33	91 J - 1,800	IR84-MW22-02	No	PRG
PESTICIDES/PCBs (ug/kg)						
4,4'-DDD	17,000 C	7/33	1.7 J - 46 J	IR84-DP45-03	No	PRG
4,4'-DDE	12,000 C	5/33	2 J - 16	IR84-DP52-01	No	PRG
4,4'-DDT	12,000 C	5/33	2.5 - 120 J	IR84-DP52-01	No	PRG
alpha-Chlordane	11,000 C [4]	8/33	3.3 J - 14,000 J	IR84-DP47-01	Yes	PRG
beta-BHC	2,100 C	1/33	1.7 J - 1.7 J	84-MW17-07	No	PRG
Dieldrin	150 C	3/33	1.8 - 2.4	IR84-SB01-02	No	PRG
Endrin aldehyde	260,000 N [5]	1/33	10 J - 10 J	IR84-DP15-03	No	PRG
gamma-Chlordane	11,000 C [4]	8/33	3.3 J - 18,000	IR84-DP47-01	Yes	PRG
Heptachlor epoxide	270 C	2/33	63 J - 200 J	IR84-DP46-02	No	PRG
Heptachlor	550 C	7/33	1.6 J - 6,900	IR84-DP47-01	Yes	PRG
Methoxychlor	4,400,000 N	3/33	2.9 J - 24 J	IR84-DP15-03	No	PRG
Aroclor-1248	10,000 N [6]	1/39	47,000 - 47,000	IR84-DP47-01	Yes	EPA
Aroclor-1254	10,000 N [6]	1/39	5,000 - 5,000	IR84-DP46-02	No	EPA
Aroclor-1260	10,000 N [6]	11/39	13 J - 45,000	IR84-DP18-02	Yes	EPA
PCB - Ensys Test Kit Results	10,000 N [6]	4/5	1,000 - > 50,000	IR84-DP18-02	Yes	EPA

TABLE 2-9 (continued)
SUBSURFACE SOIL DATA AND COC SELECTION SUMMARY (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COC Selection	
	Industrial Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
TOTAL PETROLEUM HYDROCARBONS (ug/kg)						
TPH (as Diesel)	10,000 [7]	8/8	15,000 - 5,500,000	IR84-DP15-03	Yes	UST
TPH (as Gasoline)	40,000 [7]	2/8	220 - 580,000	IR84-DP15-03	Yes	UST
METALS (mg/kg)						
Aluminum	100,000 N	33/33	589 - 7210	IR84-DP77-03	No	PRG
Antimony	820 N	8/33	0.6 J - 1.3 B	IR84-DP15-03	No	PRG
Arsenic	26.2 C [3]	29/33	0.33 J - 2	IR84-DP15-03,IR84-DP79-02D	No	PRG
Barium	100,000 N	21/33	0.92 J - 24.3	IR84-DP49-01	No	PRG
Beryllium	2,200 N	5/33	0.051 J - 0.13 B	IR84-DP15-03	No	PRG
Cadmium	810 N	7/33	0.05 J - 0.18 J	IR84-DP49-01	No	PRG
Calcium	NE	33/33	71.4 J - 66,800 J	IR84-SB03-02	No	NA
Chromium	450 N	33/33	1.2 - 9.9	IR84-DP45-03	No	PRG
Cobalt	100,000 N	27/33	0.16 J - 0.69 J	IR84-DP52-01	No	PRG
Copper	76,000 N	29/33	0.34 J - 25.5	IR84-DP50-01	No	PRG
Iron	100,000 N	33/33	155 - 6140	IR84-DP15-03	No	PRG
Lead	400 N [8]	33/33	0.87 - 52.7	IR84-DP49-01	No	EPA
Magnesium	NE	33/33	16.4 J - 943	IR84-SB03-02	No	NA
Manganese	32,000 N	33/33	0.48 J - 50.5	IR84-SB03-02	No	PRG
Mercury	610 N	23/33	0.0092 J - 0.055 J	IR84-DP46-02	No	PRG
Nickel	41,000 N	32/33	0.42 J - 3.5 J	IR84-DP50-01	No	PRG
Potassium	NE	27/33	21.3 J - 195 J	IR84-DP77-03	No	NA
Selenium	10,000 N	8/33	0.39 J - 0.73	IR84-SB03-02	No	PRG
Sodium	NE	1/33	89.7 J - 89.7 J	IR84-SB03-02	No	NA
Thallium	512 [3]	5/33	0.64 J - 0.9 J	IR84-SB03-02	No	PRG
Vanadium	14,000 N	33/33	1.1 J - 11.4	IR84-DP79-02D	No	PRG
Zinc	100,000 N	29/33	1.4 J - 42.6 J	IR84-DP49-01	No	PRG

Notes:

C - Carcinogenic
N - Non-Carcinogenic
NE - Not Established
NA - Not Applicable
PRG - Preliminary Remediation Goal
COC - Chemical of Concern
RBC - Region III Risk-Based Concentration
UCL - Upper Confidence Limit
ug/kg - microgram per kilogram
mg/kg - milligram per kilogram
EPA - OSWER directive for industrial land use
UST - North Carolina Underground Storage Tank Program

J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Industrial Preliminary Remediation Goals
(2) USEPA Region III Industrial RBC
(3) North Carolina Soil to Groundwater Concentration
(4) Screening value for chlordane used as a surrogate
(5) Screening value for endrin used as a surrogate
(6) EPA OSWER directive for industrial land use. Low-occupancy remedial goals for PCBs under TSCA may be 25 ppm with no additional controls, 50 ppm if area is secured with fencing and 100 ppm if area is capped with a soil, concrete or asphalt cover
(7) TPH Cleanup goal for low boiling point fuels (gasolene range) under North Carolina UST Regulations
(8) EPA action level for lead

TABLE 2-10
LAGOON SEDIMENT DATA AND COC SELECTION SUMMARY (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]	Contaminant Frequency / Range / Location			COPC Selection	
	Screening Value	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COPC?	Basis for Screening Criteria
VOLATILES (ug/kg)						
Xylenes (total)	210,000 S	1/1	910 J	IR84-SD07-98B	No	PRG
SEMIVOLATILES (ug/kg)						
2-Methylnaphthalene	1,600,000 N [2]	1/1	10,000	IR84-SD07-98B	No	Region III
Naphthalene	190,000 C	1/1	2,000	IR84-SD07-98B	No	PRG
Phenanthrene	59,600 N [3]	1/1	2,500	IR84-SD07-98B	No	PRG
bis(2-Ethylhexyl) phthalate	180,000 N	1/1	2,400 J	IR84-SD07-98B	No	PRG
PCBs (ug/kg)						
Aroclor-1248	10,000 C [4]	1/7	2,800	84-SD05-01	No	EPA
Aroclor-1260	10,000 C [4]	7/7	3,700 - 40,000	IR84-SD01-98B	Yes	EPA
TOTAL PETROLEUM HYDROCARBONS (ug/kg)						
Diesel Range Organics	40,000 [5]	4/4	3,500 - 14,000	IR84-SD01-98BD	No	UST

Notes:

C - Carcinogenic
N - Non-Carcinogenic
S - Soil Saturation
PRG - Preliminary Remediation Goal
COC - Chemical of Concern
UCL - Upper Confidence Limit
ug/kg - microgram per kilogram
EPA - OSWER directive for industrial land use
UST - North Carolina Underground Storage Tank Program

J - Analyte present - Reported value is estimated

Shaded constituents were identified as COCs for the Feasibility Study

(1) USEPA Region IX Industrial Preliminary Remediation Goals
(2) USEPA Region III Industrial RBC
(3) North Carolina Soil to Groundwater Concentration
(6) EPA OSWER directive for industrial land use. Low-occupancy remedial goals for PCBs under TSCA may be 25 ppm with no additional controls, 50 ppm if area is secured with fencing and 100 ppm if area is capped with a soil, concrete or asphalt cover.
(5) TPH Cleanup goal for low boiling point fuels (gasolene range) under North Carolina UST Regulations

TABLE 2-11
FINAL SOIL COCs AND REMEDIATION GOALS (LOW-OCCUPANCY LAND USE)
OPERABLE UNIT NO. 19, SITE 84 / BUILDING 45 AREA
FEASIBILITY STUDY, CTO -0219
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Remedial Goal	Basis For Remedial Goal
Aroclor-1260	10 ppm (1)	EPA
Aroclor-1248	10 ppm (1)	EPA
Aroclor-1254	10 ppm (1)	EPA
Benzo(a)anthracene	2,900 ug/kg	PRG
Benzo(a)pyrene	290 ug/kg	PRG
Benzo(b)fluoranthene	2,900 ug/kg	PRG
Benzo(k)fluroanthene	29,000 ug/kg	PRG
Dibenz(a,h)anthracene	290 ug/kg	PRG
Dieldrin	150 ug/kg	PRG
alpha-Chlordane	11,000 ug/kg (2)	PRG
gamma-Chlordane	11,000 ug/kg (2)	PRG
Heptachlor	550 ug/kg	PRG
Heptachlor epoxide	270 ug/kg	PRG
Indeno(1,2,3-cd)pyrene	2,900 ug/kg	PRG
Phenanthrene	59,600 ug/kg (3)	PRG
TPH (Diesel Range Organics)	40,000 ug/kg	UST
TPH (Gasoline Range Organics)	10,000 ug/kg	UST

Notes:

PRG - EPA Region IX Preliminary Remediation Goal (Industrial)
UST - North Carolina Underground Storage Tank Program
EPA - OSWER directive for industrial land use
ug/kg - microgram per kilogram
ppm - parts per million (same as milligram per kilogram)

(1) EPA OSWER directive for industrial land use. Low-occupancy remedial goals for PCBs under TSCA may be 25 ppm with no additional controls, 50 ppm if area is secured with fencing and 100 ppm if area is capped with a soil, concrete or asphalt cover
(2) Screening value for Chlordane used as a surrogate
(3) North Carolina Soil - to - Groundwater Concentration

TABLE 2-12
PRELIMINARY REMEDIATION GOALS (PRGs)
ADULT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

RGOs from accidental ingestion and dermal contact with soil are calculated as follows:

RGOc (mg/kg) = ICR / [(Ing *CSFo)+ (Derm*CSFd)] Ingestion = CF*ED*EF*IR-S*FI / AT-C or AT-N*BW
RGOnc (mg/kg) = HQ / [(Ing/RfDo) + (Derm/RfDd)] Dermal = CF*ED*EF*SA*AF*ABS / AT-C or AT-N*BW

Where:

Parameter	Units	Description	INPUTS	Parameter	Units	Description	INPUTS
RGOc	mg/kg	Carcinogenic contaminant concentration in surface soil	calculated	CF	kg/mg	Conversion factor	1.00E-06
RGOnc	mg/kg	Noncarcinogenic contaminant concentration in surface soil	calculated	ED	years	Exposure duration	24
RfDo	mg/kg-day	Oral reference dose (chemical specific)	CS	EF	days/year	Exposure frequency	48
RfDd	mg/kg-day	Dermally adjusted reference dose	CS	IR-S	mg/day	Ingestion rate	100
CSFo	$(mg/kg\text{-}day)^{-1}$	Oral cancer slope factor	CS	FI	NA	Fraction Ingested	1
CSFd	$(mg/kg\text{-}day)^{-1}$	Dermally adjusted cancer slope factor	CS	SA	cm2/day	Skin surface area available for contact	5,800
ABS	NA	Absorption Factor	CS	AF	mg/cm2	Soil to skin adherence factor	1
AT-C	days	Averaging time for carcinogen	25,550	BW	kg	Body weight	70
AT-N	days	Averaging time for noncarcinogen	8,760				

Note: Inputs are scenario and site specific

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	21.3	1.88E-07	1.42E-06	--
Benzo(a)pyrene	1.00E-06	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	2.1	1.88E-07	1.42E-06	--
Benzo(b)fluoranthene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	21.3	1.88E-07	1.42E-06	--
Benzo(k)fluoranthene	1.00E-06	1.0	0.13	7.30E-02	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Carbazole	1.00E-06	1.0	0.13	2.00E-02	NA	NA	NA	6.44E-08	4.86E-07	776.3	1.88E-07	1.42E-06	--
Chrysene	1.00E-06	1.0	0.13	7.30E-03	NA	NA	NA	6.44E-08	4.86E-07	2126.7	1.88E-07	1.42E-06	--
Dibenz(a,h)anthracene	1.00E-06	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	2.1	1.88E-07	1.42E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	21.3	1.88E-07	1.42E-06	--
Pesticides													
4,4'-DDD	1.00E-06	1.0	0.1	2.40E-01	2.40E-01	NA	NA	6.44E-08	3.74E-07	9.5	1.88E-07	1.09E-06	--
Chlordane, alpha-	1.00E-06	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	11.4	1.88E-07	4.36E-07	682
Chlordane, gamma-	1.00E-06	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	11.4	1.88E-07	4.36E-07	682
Dieldrin	1.00E-06	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	6.44E-08	3.74E-07	0.1	1.88E-07	1.09E-06	21
Heptachlor	1.00E-06	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	6.44E-08	3.74E-07	0.5	1.88E-07	1.09E-06	391
Heptachlor Epoxide	1.00E-06	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	6.44E-08	3.74E-07	0.3	1.88E-07	1.09E-06	10
PCBs													
Aroclor-1248	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	0.8	1.88E-07	1.53E-06	--
Aroclor-1254	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	6.44E-08	5.23E-07	0.8	1.88E-07	1.53E-06	11
Aroclor-1260	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	0.8	1.88E-07	1.53E-06	--

TABLE 2-12 (continued)
PRELIMINARY REMEDIATION GOALS (PRGs)
ADULT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Benzo(a)pyrene	1.00E-05	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	21.3	1.88E-07	1.42E-06	--
Benzo(b)fluoranthene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Benzo(k)fluoranthene	1.00E-05	1.0	0.13	7.30E-02	NA	NA	NA	6.44E-08	4.86E-07	2126.7	1.88E-07	1.42E-06	--
Carbazole	1.00E-05	1.0	0.13	2.00E-02	NA	NA	NA	6.44E-08	4.86E-07	7762.6	1.88E-07	1.42E-06	--
Chrysene	1.00E-05	1.0	0.13	7.30E-03	NA	NA	NA	6.44E-08	4.86E-07	21267.4	1.88E-07	1.42E-06	--
Dibenz(a,h)anthracene	1.00E-05	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	21.3	1.88E-07	1.42E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Pesticides													
4,4'-DDD	1.00E-05	1.0	0.1	2.40E-01	2.40E-01	NA	NA	6.44E-08	3.74E-07	95.1	1.88E-07	1.09E-06	--
Chlordane, alpha-	1.00E-05	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	113.7	1.88E-07	4.36E-07	682
Chlordane, gamma-	1.00E-05	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	113.7	1.88E-07	4.36E-07	682
Dieldrin	1.00E-05	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	6.44E-08	3.74E-07	0.8	1.88E-07	1.09E-06	21
Heptachlor	1.00E-05	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	6.44E-08	3.74E-07	5.1	1.88E-07	1.09E-06	391
Heptachlor Epoxide	1.00E-05	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	6.44E-08	3.74E-07	2.5	1.88E-07	1.09E-06	10
PCBs													
Aroclor-1248	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	7.7	1.88E-07	1.53E-06	--
Aroclor-1254	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	6.44E-08	5.23E-07	7.7	1.88E-07	1.53E-06	11
Aroclor-1260	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	7.7	1.88E-07	1.53E-06	--

TABLE 2-12 (continued)
PRELIMINARY REMEDIATION GOALS (PRGs)
ADULT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	2126.7	1.88E-07	1.42E-06	--
Benzo(a)pyrene	1.00E-04	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Benzo(b)fluoranthene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	2126.7	1.88E-07	1.42E-06	--
Benzo(k)fluoranthene	1.00E-04	1.0	0.13	7.30E-02	NA	NA	NA	6.44E-08	4.86E-07	21267.4	1.88E-07	1.42E-06	--
Carbazole	1.00E-04	1.0	0.13	2.00E-02	NA	NA	NA	6.44E-08	4.86E-07	77625.9	1.88E-07	1.42E-06	--
Chrysene	1.00E-04	1.0	0.13	7.30E-03	NA	NA	NA	6.44E-08	4.86E-07	212673.6	1.88E-07	1.42E-06	--
Dibenz(a,h)anthracene	1.00E-04	1.0	0.13	7.30E+00	NA	NA	NA	6.44E-08	4.86E-07	212.7	1.88E-07	1.42E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	6.44E-08	4.86E-07	2126.7	1.88E-07	1.42E-06	--
Pesticides													
4,4'-DDD	1.00E-04	1.0	0.1	2.40E-01	2.40E-01	NA	NA	6.44E-08	3.74E-07	951.3	1.88E-07	1.09E-06	--
Chlordane, alpha-	1.00E-04	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	1137.4	1.88E-07	4.36E-07	682
Chlordane, gamma-	1.00E-04	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	6.44E-08	1.49E-07	1137.4	1.88E-07	4.36E-07	682
Dieldrin	1.00E-04	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	6.44E-08	3.74E-07	7.7	1.88E-07	1.09E-06	21
Heptachlor	1.00E-04	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	6.44E-08	3.74E-07	50.7	1.88E-07	1.09E-06	391
Heptachlor Epoxide	1.00E-04	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	6.44E-08	3.74E-07	25.1	1.88E-07	1.09E-06	10
PCBs													
Aroclor-1248	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	76.7	1.88E-07	1.53E-06	--
Aroclor-1254	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	6.44E-08	5.23E-07	76.7	1.88E-07	1.53E-06	11
Aroclor-1260	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	NA	NA	6.44E-08	5.23E-07	76.7	1.88E-07	1.53E-06	--

TABLE 2-13
PRELIMINARY REMEDIATION GOALS (PRGs)
ADOLESCENT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

RGOs from accidental ingestion and dermal contact with soil are calculated as follows:

RGOc (mg/kg) = ICR / [(Ing *CSFo)+ (Derm*CSFd)]
RGOnc (mg/kg) = HQ / [(Ing/RfDo) + (Derm/RfDd)]

Ingestion = CF*ED*EF*IR-S*FI / AT-C or AT-N*BW
Dermal = CF*ED*EF*SA*AF*ABS / AT-C or AT-N*BW

Where:

Parameter	Units	Description	INPUTS	Parameter	Units	Description	INPUTS
RGOc	mg/kg	Carcinogenic contaminant concentration in surface soil	calculated	CF	kg/mg	Conversion factor	1.00E-06
RGOnc	mg/kg	Noncarcinogenic contaminant concentration in surface soil	calculated	ED	years	Exposure duration	9
RfDo	mg/kg-day	Oral reference dose (chemical specific)	CS	EF	days/year	Exposure frequency	48
RfDd	mg/kg-day	Dermally adjusted reference dose	CS	IR-S	mg/day	Ingestion rate	100
CSFo	$(mg/kg\text{-}day)^{-1}$	Oral cancer slope factor	CS	FI	NA	Fraction Ingested	1
CSFd	$(mg/kg\text{-}day)^{-1}$	Dermally adjusted cancer slope factor	CS	SA	cm2/day	Skin surface area available for contact	3,925
ABS	NA	Absorption Factor	CS	AF	mg/cm2	Soil to skin adherence factor	1
AT-C	days	Averaging time for carcinogen	25,550	BW	kg	Body weight	45
AT-N	days	Averaging time for noncarcinogen	3,285				

Note: Inputs are scenario and site specific

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	36.5	2.92E-07	1.49E-06	--
Benzo(a)pyrene	1.00E-06	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	3.6	2.92E-07	1.49E-06	--
Benzo(b)fluoranthene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	36.5	2.92E-07	1.49E-06	--
Benzo(k)fluoranthene	1.00E-06	1.0	0.13	7.30E-02	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Carbazole	1.00E-06	1.0	0.13	2.00E-02	NA	NA	NA	3.76E-08	1.92E-07	1330.7	2.92E-07	1.49E-06	--
Chrysene	1.00E-06	1.0	0.13	7.30E-03	NA	NA	NA	3.76E-08	1.92E-07	3645.8	2.92E-07	1.49E-06	--
Dibenz(a,h)anthracene	1.00E-06	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	3.6	2.92E-07	1.49E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-06	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	36.5	2.92E-07	1.49E-06	--
Pesticides													
4,4'-DDD	1.00E-06	1.0	0.1	2.40E-01	2.40E-01	NA	NA	3.76E-08	1.47E-07	22.5	2.92E-07	1.15E-06	--
Chlordane, alpha-	1.00E-06	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	25.7	2.92E-07	4.59E-07	578
Chlordane, gamma-	1.00E-06	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	25.7	2.92E-07	4.59E-07	578
Dieldrin	1.00E-06	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	3.76E-08	1.47E-07	0.2	2.92E-07	1.15E-06	19
Heptachlor	1.00E-06	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	3.76E-08	1.47E-07	1.2	2.92E-07	1.15E-06	347
Heptachlor Epoxide	1.00E-06	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	3.76E-08	1.47E-07	0.6	2.92E-07	1.15E-06	9
PCBs													
Aroclor-1248	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	1.9	2.92E-07	1.61E-06	--
Aroclor-1254	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	3.76E-08	2.06E-07	1.9	2.92E-07	1.61E-06	10
Aroclor-1260	1.00E-06	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	1.9	2.92E-07	1.61E-06	--

TABLE 2-13 (continued)
PRELIMINARY REMEDIATION GOALS (PRGs)
ADOLESCENT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Benzo(a)pyrene	1.00E-05	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	36.5	2.92E-07	1.49E-06	--
Benzo(b)fluoranthene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Benzo(k)fluoranthene	1.00E-05	1.0	0.13	7.30E-02	NA	NA	NA	3.76E-08	1.92E-07	3645.8	2.92E-07	1.49E-06	--
Carbazole	1.00E-05	1.0	0.13	2.00E-02	NA	NA	NA	3.76E-08	1.92E-07	13307.3	2.92E-07	1.49E-06	--
Chrysene	1.00E-05	1.0	0.13	7.30E-03	NA	NA	NA	3.76E-08	1.92E-07	36458.3	2.92E-07	1.49E-06	--
Dibenz(a,h)anthracene	1.00E-05	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	36.5	2.92E-07	1.49E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-05	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Pesticides													
4,4'-DDD	1.00E-05	1.0	0.1	2.40E-01	2.40E-01	NA	NA	3.76E-08	1.47E-07	225.2	2.92E-07	1.15E-06	--
Chlordane, alpha-	1.00E-05	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	256.7	2.92E-07	4.59E-07	578
Chlordane, gamma-	1.00E-05	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	256.7	2.92E-07	4.59E-07	578
Dieldrin	1.00E-05	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	3.76E-08	1.47E-07	1.9	2.92E-07	1.15E-06	19
Heptachlor	1.00E-05	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	3.76E-08	1.47E-07	12.0	2.92E-07	1.15E-06	347
Heptachlor Epoxide	1.00E-05	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	3.76E-08	1.47E-07	5.9	2.92E-07	1.15E-06	9
PCBs													
Aroclor-1248	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	18.5	2.92E-07	1.61E-06	--
Aroclor-1254	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	3.76E-08	2.06E-07	18.5	2.92E-07	1.61E-06	10
Aroclor-1260	1.00E-05	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	18.5	2.92E-07	1.61E-06	--

TABLE 2-13 (continued)
PRELIMINARY REMEDIATION GOALS (PRGs)
ADOLESCENT RECREATIONAL USERS - SURFACE SOIL EXPOSURE
COMBINED INGESTION AND DERMAL ROUTES OF EXPOSURE
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB CAMP LEJEUNE - JACKSONVILLE, NC

Contaminant	ICR (unitless)	HQ (unitless)	ABS (unitless)	CSFo (Kg/day-mg)	CSFd (Kg/day-mg)	RfDo (mg/kg-day)	RfDd (mg/kg-day)	Carcinogenic			Noncarcinogenic		
								Ingestion Dose	Dermal Dose	RGO (mg/kg)	Ingestion Dose	Dermal Dose	RGO (mg/kg)
Semivolatiles													
Benzo(a)anthracene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	3645.8	2.92E-07	1.49E-06	--
Benzo(a)pyrene	1.00E-04	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Benzo(b)fluoranthene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	3645.8	2.92E-07	1.49E-06	--
Benzo(k)fluoranthene	1.00E-04	1.0	0.13	7.30E-02	NA	NA	NA	3.76E-08	1.92E-07	36458.3	2.92E-07	1.49E-06	--
Carbazole	1.00E-04	1.0	0.13	2.00E-02	NA	NA	NA	3.76E-08	1.92E-07	133072.9	2.92E-07	1.49E-06	--
Chrysene	1.00E-04	1.0	0.13	7.30E-03	NA	NA	NA	3.76E-08	1.92E-07	364583.3	2.92E-07	1.49E-06	--
Dibenz(a,h)anthracene	1.00E-04	1.0	0.13	7.30E+00	NA	NA	NA	3.76E-08	1.92E-07	364.6	2.92E-07	1.49E-06	--
Indeno(1,2,3-cd)pyrene	1.00E-04	1.0	0.13	7.30E-01	NA	NA	NA	3.76E-08	1.92E-07	3645.8	2.92E-07	1.49E-06	--
Pesticides													
4,4'-DDD	1.00E-04	1.0	0.1	2.40E-01	2.40E-01	NA	NA	3.76E-08	1.47E-07	2251.7	2.92E-07	1.15E-06	--
Chlordane, alpha-	1.00E-04	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	2566.8	2.92E-07	4.59E-07	578
Chlordane, gamma-	1.00E-04	1.0	0.04	3.50E-01	4.38E-01	5.00E-04	4.00E-04	3.76E-08	5.90E-08	2566.8	2.92E-07	4.59E-07	578
Dieldrin	1.00E-04	1.0	0.1	1.60E+01	3.20E+01	5.00E-05	2.50E-05	3.76E-08	1.47E-07	18.8	2.92E-07	1.15E-06	19
Heptachlor	1.00E-04	1.0	0.1	4.50E+00	4.50E+00	5.00E-04	5.00E-04	3.76E-08	1.47E-07	120.1	2.92E-07	1.15E-06	347
Heptachlor Epoxide	1.00E-04	1.0	0.1	9.10E+00	9.10E+00	1.30E-05	1.30E-05	3.76E-08	1.47E-07	59.4	2.92E-07	1.15E-06	9
PCBs													
Aroclor-1248	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	185.5	2.92E-07	1.61E-06	--
Aroclor-1254	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	2.00E-05	1.78E-05	3.76E-08	2.06E-07	185.5	2.92E-07	1.61E-06	10
Aroclor-1260	1.00E-04	1.0	0.14	2.00E+00	2.25E+00	NA	NA	3.76E-08	2.06E-07	185.5	2.92E-07	1.61E-06	--

TABLE 2-14
FINAL SOIL COCs AND REMEDIATION GOALS (RECREATIONAL LAND USE)
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, SITE 84 / BUILDING 45 AREA
MCB, CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Selected Remedial Goal (mg/kg)	Basis for Remedial Goal	Risk-Based Remediation Goals					
			Recreational Adult[3]			Recreational Adolescent[4]		
			1×10^{-6} ICR	1×10^{-5} ICR	1×10^{-4} ICR	1×10^{-6} ICR	1×10^{-5} ICR	1×10^{-4} ICR
Aroclor-1248	7.7	RISK[1]	0.8	7.7	76.7	1.9	18.5	185.5
Aroclor-1254	7.7	RISK[1]	0.8	7.7	76.7	1.9	18.5	185.5
Aroclor-1260	7.7	RISK[1]	0.8	7.7	76.7	1.9	18.5	185.5
Benzo(a)anthracene	212.7	RISK[1]	21.3	212.7	2126.7	36.5	364.6	3645.8
Benzo(a)pyrene	21.3	RISK[1]	2.1	21.3	212.7	3.6	36.5	364.6
Benzo(b)fluoranthene	212.7	RISK[1]	21.3	212.7	2126.7	36.5	364.6	3645.8
Benzo(k)fluoranthene	2126.7	RISK[1]	212.7	2126.7	21267.4	364.6	3645.8	36458.3
Dibenz(a,h)anthracene	21.3	RISK[1]	2.1	21.3	212.7	3.6	36.5	364.6
Carbazole	7762.6	RISK[1]	776.3	7762.6	77625.9	1330.7	13307.3	133072.9
alpha-Chlordane	113.7	RISK[1]	11.4	113.7	1137.4	25.7	256.7	2566.8
gamma-Chlordane	113.7	RISK[1]	11.4	113.7	1137.4	25.7	256.7	2566.8
Chrysene	21267.4	RISK[1]	2126.7	21267.4	212673.6	3645.8	36458.3	364583.3
4,4'-DDD	95.1	RISK[1]	9.5	95.1	951.3	22.5	225.2	2251.7
Dieldrin	0.8	RISK[1]	0.1	0.8	7.7	0.2	1.9	18.8
Heptachlor	5.1	RISK[1]	0.5	5.1	50.7	1.2	12.0	120.1
Heptachlor epoxide	2.5	RISK[1]	0.3	2.5	25.1	0.6	5.9	59.4
Indeno(1,2,3-cd)pyrene	212.7	RISK[1]	21.3	212.7	2126.7	36.5	364.6	3645.8
TPH (Diesel Range Organics)	40	UST[2]						
TPH (Gasoline Range Organics)	10	UST[2]						

Notes:

(1) RISK - Site-specific, risk-based remedial goal based on adult recreational user and 1×10^{-5} cancer risk.

(2) UST - North Carolina Underground Storage Tank Program

(3) See Table 2-12 for derivation of risk-based remediation goals for the recreational adult.

(4) See Table 2-13 for derivation of risk-based remediation goals for the recreational adolescent.

mg/kg - milligram per kilogram

TABLE 2-15
GROUNDWATER DATA AND COC SELECTION SUMMARY
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Screening Criteria [1]		Contaminant Frequency / Range / Location			COC Selection	
	MCL	NCWQS	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Selected as a COC?	Basis for Screening Criteria
VOLATILES (ug/L)							
2-Butanone	1,900 [2]	170	2/20	0.53 J - 0.69 J	IR84-MW22-01C	No	NCWQS
Benzene	5	1	2/20	1.5 J - 3.4 J	AST781-GW03-98B	Yes	NCWQS
Carbon disulfide	1,000 [2]	700 [3]	1/20	0.49 J - 0.49 J	IR84-MW18-01C	No	NCWQS
Chloroform	80 (p)	0.19	2/20	16 - 16	AST781-GW11-98B,AST781-GW12-98B	Yes	NCWQS
Chloromethane	NE	NE	2/20	0.17 J - 0.62 J	IR84-MW18-01C	No	NCWQS
Ethylbenzene	700	29	4/20	0.6 J - 6.7 J	AST781-GW04-98B	No	NCWQS
Methyl tert-butyl ether	20 [2]	200	1/20	0.52 J - 0.52 J	IR84-MW16-01C	No	MCL
Methylene chloride	5	5	3/20	0.37 J - 0.7 J	IR84-MW22-01C	No	NCWQS
Trichloroethene	5	2.8	1/20	0.19 J - 0.19 J	IR84-MW17-01C	No	NCWQS
Xylenes (total)	10,000	530	1/20	1.8 - 1.8	IR84-MW17-01C	No	NCWQS
SEMIVOLATILES (ug/L)							
2-Methylnaphthalene	NE	28 [3]	2/14	1 J - 1.1 J	IR84-MW20-01CD	No	NCWQS
Naphthalene	6.2 [2]	21	1/14	2.2 J - 2.2 J	IR84-MW22-01C	No	MCL
PESTICIDES (ug/L)							
4,4'-DDD	0.28 [2]	0.14 [3]	4/14	0.028 J - 0.044 J	IR84-MW18-01C	No	NCWQS
4,4'-DDE	0.2 [2]	NE	2/14	0.024 J - 0.026 J	IR84-MW20-01CD	No	MCL
4,4'-DDT	0.2 [2]	0.1 [3]	4/14	0.029 J - 0.047 J	IR84-MW20-01CD	No	NCWQS
Endosulfan I	220 [2]	NE	1/14	0.023 J - 0.023 J	IR84-MW18-01C	No	MCL
Heptachlor epoxide	0.2	0.004	1/14	0.03 J - 0.03 J	IR84-MW20-01C	Yes	NCWQS
beta-BHC	0.037 [2]	NE	4/14	0.021 J - 0.029 J	IR84-MW21-01C	No	MCL
gamma-Chlordane	2 [4]	0.027 [4]	1/14	0.04 J - 0.04 J	IR84-MW18-01C	Yes	NCWQS
HERBICIDES (ug/L)							
Dinoseb	7	NE	4/14	0.015 J - 1.5 J	IR84-MW17-01C	No	MCL
MCPA	NE	NE	1/14	44 J - 44 J	IR84-MW18-01C	No	NA
METALS (mg/L)							
Aluminum	0.20 (s)	NE	9/14	0.44 - 0.73	IR84-MW17-01C	Yes	MCL
Antimony	0.006	NE	3/14	0.0022 J - 0.011 J	IR84-MW17-01C	Yes	MCL
Arsenic	0.01	0.05	4/14	0.0071 J - 0.03	IR84-MW08-01C	Yes	MCL
Barium	2	2	14/14	0.0036 J - 0.12 J	IR84-MW18-01C	No	NCWQS
Beryllium	0.004	NE	14/14	0.00057 J - 0.0011 J	IR84-MW10-01C,IR84-MW10-01C	No	MCL
Cadmium	0.005	0.005	2/14	0.00056 J - 0.00061 J	IR84-MW23-01C	No	NCWQS
Calcium	NE	NE	14/14	1.4 J - 106	IR84-MW07-01C	No	NCWQS
Chromium	0.1	0.05	3/14	0.0015 J - 0.0022 J	IR84-MW19-01C	No	NCWQS
Cobalt	2.2 [2]	NE	3/14	0.0022 J - 0.0057 J	IR84-MW18-01C	No	MCL
Iron	0.3	0.3	12/14	0.18 - 67.7	IR84-MW08-01C	Yes	NCWQS
Magnesium	NE	NE	14/14	0.34 J - 11.3	IR84-MW18-01C	No	NA
Manganese	0.05	0.05	14/14	0.004 J - 0.45	IR84-MW07-01C	Yes	NCWQS
Mercury	0.002	0.0011	1/14	0.000072 J - 0.000072 J	IR84-MW17-01C	No	NCWQS
Nickel	0.730 [2]	0.1	2/14	0.0027 J - 0.011 J	IR84-MW18-01C	No	NCWQS
Potassium	NE	NE	11/14	0.86 J - 11	IR84-MW21-01C	No	NA
Sodium	NE	NE	14/14	2.1 J - 22	IR84-MW19-01C	No	NA
Thallium	0.002	NE	2/14	0.0054 J - 0.0057 J	IR84-MW08-01C	Yes	MCL
Vanadium	0.26 [2]	NE	10/14	0.00084 J - 0.0037 J	IR84-MW21-01C	No	MCL
Zinc	5 (s)	2.1	3/14	0.013 J - 0.31	IR84-MW18-01C	No	NCWQS

Notes:

NA - Not Applicable
NE - Not Established
(p) proposed
COC - Chemical of Concern
NCWQS - North Carolina Water Quality 2L Standard
(s) Secondary drinking water standard
ug/L - microgram per liter
MCL - Maximum Contaminant Level
J - Analyte present - Reported value is estimated

B -The reported value is less than Contract-Required Detection Limits (CRDL), but greater than Instrument Detection Limits (IDC)

Shaded constituents were identified as COCs for the Feasibility Study

(1) NCWQS 2L , MCL

(2) No MCL available, value is Region IX Tapwater standard

(3) Interim Standard

(4) Value for Chlordane

TABLE 2-16
FINAL GROUNDWATER COCs AND REMEDIATION GOALS
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	Remedial Goal	Basis for Remedial Goal
VOLATILES (ug/L)		
Benzene	1	NCWQS
Chloroform	0.19	NCWQS
PESTICIDES (ug/L)		
Heptachlor epoxide	0.004	NCWQS
gamma-Chlordane	0.027 (1)	NCWQS
METALS (mg/L)		
Aluminum	0.2 (2)	MCL
Antimony	0.006	MCL
Arsenic	0.01	MCL
Iron	0.3	NCWQS
Manganese	0.05	NCWQS
Thallium	0.002	MCL

Notes:

MCL - Federal Drinking Water Standard
ug/L - microgram per liter
mg/L - milligram per liter

COC - Chemical of Concern
NCWQS - North Carolina 2L Standard

(1) Screening value for Chlordane used
(2) Secondary drinking water standard

TABLE 3-1
POTENTIAL REMEDIAL ACTION TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	General Response Action	Remedial Action Technology Type	Process Option
Soil/Sediment	No Action	No Action	No Action
	Institutional Controls	Site Access Restrictions	Fencing, signs
		Land Use Restrictions	Deeds
	Containment/Removal Actions	Capping	Clay/Soil Cap
			Asphalt/Concrete Cap
			Multi-layered Cap
		Consolidation	Consolidation into lagoon
		Excavation	Excavation
		Disposal	Landfill Disposal
	Treatment Actions (Ex-Situ)	Thermal Treatment	Incineration
			Thermal Desorption
			Base-Catalyzed Decomposition Process (BCDP)
			Pyrolysis
		Physical/Chemical Treatment	Solidification/Stabilization
			Glycolate Dechlorination
			Solvated Electron Technology
			Soil Washing
			Solar Detoxification
			Solvent Extraction
		Biological Treatment	Slurry Phase Bioremediation
			White Rot Fungus
	Treatment Actions (In-Situ)	Thermal Treatment	In-situ Vitrification
			Thermal Desorption
			Thermally Enhanced Soil Vapor Extraction
		Biological	Augmented Bioremediation
			Phytoremediation
		Physical/Chemical Treatment	Coralplex Dechlorination
			Solidification/Stabilization

TABLE 3-2
PRELIMINARY SCREENING OF REMEDIAL ACTION TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology Type	Process Option	Description	Site-Specific Applicability	Screening Results
No Action	No Action	No Action	Contaminated soils and sediments remain on site. No institutional controls.	▪ Potentially Applicable	**Retained**
Institutional Controls	Site Access Restrictions	Fencing, posting signs	Restrict site access to keep potential receptors from contact with contaminated soils.	▪ Potentially Applicable	**Retained**
	Land Use Restrictions	Deed Restrictions	Contaminated areas have permanent land use restrictions implemented that would limit future development and restrict future land use.	▪ Potentially Applicable	**Retained**
Containment/ Removal Actions	Capping	Clay/Soil Cap Asphalt/Concrete Cap Multi-layered Cap	A cap reduces potential for direct exposure to the contaminated soil and minimizes further migration of contaminated soils/sediments due to runoff/erosion.	▪ Potentially Applicable	**Retained**
	Consolidation	Consolidation into lagoon	Soils and sediments contaminated above cleanup levels would be excavated and consolidated on-site in the lagoon with the contaminated lagoon sediments.	▪ Potentially Applicable	**Retained**
	Excavation	Excavation	Soil and sediments contaminated above cleanup levels will be excavated for subsequent treatment or disposal.	▪ Potentially Applicable	**Retained**
	Disposal	Off-Site Landfill	Permitted off-site landfill disposal facilities accept the contaminated soils and sediments for disposal.	▪ Potentially Applicable	**Retained**
Treatment Actions (Ex-Situ)	Thermal Treatment	Incineration	Established technology for treatment of organic contaminants via combustion. Off-gas treatment required. Metals in soil may limit applicability.	▪ Potentially Applicable	**Retained**
		Thermal Desorption	Wastes are heated to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system.	▪ Potentially Applicable	**Retained**
		Base-Catalyzed Decomposition Process (BCDP)	Catalytic transfer hydrogenation reaction by which halogen atoms are removed and replaced by hydrogen atoms.	▪ Potentially Applicable	**Retained**
		Pyrolysis	Chemical decomposition is induced in organic materials by heat, and transformed into gaseous components and a solid residue containing fixed carbon and ash.	▪ Moisture content of <1% required ▪ Media with heavy metals may require stabilization	Eliminated
	Physical/Chemical Treatment	Glycolate Dechlorination	Reaction causes the polyethylene glycol to replace halogen molecules and render the compound nonhazardous or less toxic	▪ May not be effective for non-halogenated contaminants ▪ May not meet remediation goals	Eliminated
		Solvated Electron Technology	Sodium or calcium-generated solvated electrons are used as a reducing agent to strip halogen atoms from the carbon ring of halogenated contaminants.	▪ May not be effective for non-halogenated contaminants ▪ May not meet remediation goals	Eliminated

TABLE 3-2 (continued)
PRELIMINARY SCREENING OF REMEDIAL ACTION TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology Type	Process Option	Description	Site-Specific Applicability	Screening Results
Treatment Actions (Ex-Situ) (cont'd)	Physical/Chemical Treatment (cont'd)	Soil Washing	Contaminants attached to fine soil particles are separated from coarse-grained soil in order to reduce the volume of soil to be treated.	▪ Potentially Applicable	**Retained**
		Solar Detoxification	Ultraviolet light activates the catalyst, resulting in the formation of reactive radicals that break down contaminants into non-toxic by-products.	▪ Effective during daylight hours only ▪ May only remove heavy metals from water and not soil	Eliminated
		Solvent Extraction	Contaminated soil and extractant are mixed together, and the extracted solution is separated for treatment and future use.	▪ Traces of solvent remains in treated soils ▪ May not meet remediation goals	Eliminated
	Biological Treatment	Slurry Phase Bioremediation	Controlled treatment of excavated soil, often in a lagoon. This aqueous-phase system allows contaminants to remain in a lagoon, mix with nutrients and water, and degrade.	▪ Biological treatment unproven for PCBs ▪ Dewatering soil fines after treatment may be expensive ▪ Nonrecycled wastewater must be disposed of or treated	Eliminated
		White Rot Fungus	White Rot Fungus has been known to degrade organic recalcitrants, utilizing moist air and wood chips in a bioreactor.	▪ Biological treatment unproven for PCBs ▪ Experimental technology for PCBs - may not meet remediation goals	Eliminated
Treatment Actions (In-Situ)	Thermal Treatment	Thermal Desorption	Electrical heaters installed inside wells that are evenly spaced in the soil. Contaminants are captured because the system is under vacuum.	▪ Unproven technology for PCBs ▪ May not meet remediation goals	Eliminated
			Thermal blankets or thermal wells increase the temperature of the surrounding soil and initialize the conduction and convection processes.	▪ Effective in heterogeneous soil, and soils with high moisture content ▪ Case studies have proven this effective for PCBs	**Retained**
		Thermally Enhanced Soil Vapor Extraction	Many heating options are available to increase the volatilization rate of semi-volatiles and facilitate extraction of contaminants.	▪ Limited by high moisture content ▪ Must also regulate air emissions	Eliminated
	Biological	Augmented Bioremediation	Microbes added to the soil actively break down contaminants in the soil.	▪ High soil pH may be a factor ▪ Biological treatment unproven for PCBs	Eliminated
		Phytoremediation	Phytoextraction can take place when plants absorb contaminants into underground or aboveground biomass. Phytostabilization utilizes plants to reduce contaminant mobility.	▪ Not proven for PCBs ▪ Contamination bioaccumulates in plants. ▪ May be seasonal	Eliminated
	Physical/Chemical Treatment	Coralplex Dechlorination	On-site treatment technology that dechlorinates PCB compounds through a series of chemical reactions.	▪ Not effective for non-halogenated organics ▪ Unproven for PCBs	Eliminated
		Solidification/ Stabilization	An in-situ physical and chemical technology that immobilizes contaminants within their host medium	▪ Future site use may be hindered by the solidified contaminants remaining on site ▪ Target contaminant group is inorganics	Eliminated

TABLE 3-3
SUMMARY OF THE PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBLITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology Type	Process Option	Evaluation			Evaluation Results
			Effectiveness	Implementability	Relative Cost	
No Action	No Action	No Action	▪ Not effective for managing risks or protecting the environment ▪ Relies on long-term natural attenuation processes	▪ Easily implemented ▪ No means to monitor site conditions	No cost	**Retained** as per the requirements of the NCP
Institutional Controls	Site Access Restrictions	Fencing, posting signs	▪ Limits human access/exposure and protects human health ▪ Not effective for limiting ecological exposure ▪ Contaminants still present in soil ▪ Not effective in limiting contaminant migration due to runoff, erosion, and flooding ▪ Equally effective for metal, PCB, TPH and PAH contamination	Easily Implemented	▪ Low capital costs ▪ Low O & M costs	**Retained**
	Land Use Restrictions	Deed restrictions	▪ Limits future development and land use at the site ▪ Limits human exposure and protects human health ▪ Not effective for limiting ecological exposure ▪ Contaminants still present in soil ▪ Not effective in limiting contaminant migration due to runoff, erosion, and flooding ▪ Equally effective for metal, PCB, TPH and PAH contamination	Easily Implemented	Negligible cost	**Retained**
Containment/ Removal Actions	Capping	Clay/Soil Cap Asphalt/Concrete Cap Multi-layered Cap	▪ Prevents direct contact with contaminated soils ▪ Contaminants still present in soil ▪ Minimizes migration due to runoff and erosion ▪ May not limit contaminant migration in floodplain ▪ Equally effective for metal, PCB, TPH and PAH contamination	▪ Standard construction equipment required ▪ Permanent erosion, sediment and flood controls required ▪ TSCA regulated soils must first be transported off-site	▪ Low to moderate capital costs ▪ Low O & M costs	**Retained**

TABLE 3-3 (continued)
SUMMARY OF THE PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBLITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology Type	Process Option	Evaluation			Evaluation Results
			Effectiveness	Implementability	Relative Cost	
Containment/ Removal Actions (cont'd)	Consolidation	Consolidation into lagoon	▪ Prevents direct contact with contaminated soils ▪ Contaminants still present in soil ▪ Equally effective for metal, PCB, TPH and PAH contamination ▪ Consolidates site contamination into one area	▪ Excavation required ▪ Standard construction equipment required ▪ TSCA regulated soils must first be transported off-site ▪ Lagoon area will require a cap	▪ Moderate capital costs ▪ Low O & M costs	Eliminated due to availability of Base landfill for disposal of non-TSCA regulated soils
	Excavation	Excavation	▪ Effective in removal of contaminated soil and sediment for subsequent treatment or disposal	▪ Pre- and post-excavation sampling may be required ▪ Soil dewatering may be required for wet soils/sediments ▪ Difficult to implement in wetland/wooded areas	▪ Low to moderate capital costs ▪ No O&M costs	**Retained**
	Disposal	Landfill Disposal	▪ Contaminants removed from site and placed away from human and ecological exposure pathways ▪ Equally effective for PCB, metal, TPH and PAH contamination	▪ Excavation required ▪ Landfill must be permitted to accept contaminants ▪ On-site pre-screening or dewatering may be required ▪ Easily implemented	▪ Moderate to high capital costs ▪ No O & M costs ▪ More cost effective if material can be disposed in Base landfill	**Retained**
Treatment Actions (Ex-Situ) *Assuming excavation*	Thermal Treatment	Incineration	▪ Established treatment technology for organic contaminants	▪ Volatile heavy metals, such as arsenic, will require the installation of gas cleaning systems ▪ Contaminants removed from the site ▪ Long distance transport required for off-site treatment	▪ High capital costs	Eliminated due to high cost. Not cost effective for low levels of organic contamination. Off-site incineration may be effective for treatment process residuals, but not as a primary treatment method.
		Thermal Desorption	▪ Proven to be effective for PCB's, inorganics and SVOCs	▪ On-site or off-site technology ▪ On-site pre-screening and dewatering may be necessary ▪ Heavy metals in the soil may result in a treated solid residue that requires stabilization ▪ Liquid and baghouse waste requires treatment ▪ Long distance transport required for off-site treatment	▪ Moderate to high capital costs ▪ Moderate O & M costs	Eliminated due to high cost. Not cost effective for low levels of organic contamination. Off-site thermal desorption may be effective for treatment process residuals, but not as a primary treatment method.

TABLE 3-3 (continued)
SUMMARY OF THE PROCESS OPTION EVALUATION
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBLITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

General Response Action	Remedial Action Technology Type	Process Option	Evaluation			Evaluation Results
			Effectiveness	Implementability	Relative Cost	
Treatment Actions (Ex-Situ) *Assuming excavation* (cont'd)	Thermal Treatment (cont'd)	Base-Catalyzed Decomposition Process (BCDP)	▪ Proven to destroy PCBs and other chlorinated organics to meet regulatory requirements ▪ Efficient, relatively inexpensive treatment process ▪ Not effective on non-chlorinated organics ▪ High levels of metals impacts treatment process	▪ On-site pre-screening and dewatering necessary ▪ Air permits must be obtained ▪ Volatilized contaminants must go through secondary treatment ▪ A full-scale system can be fabricated and placed in operation in 6 to 12 months	▪ Moderate capital costs ▪ Moderate O & M costs	Eliminated because it is not effective for non-chlorinated contaminants.
	Physical/Chemical Treatment	Soil Washing	▪ Target contaminant groups include SVOCs and heavy metals ▪ Effectively reduces the volume of soil to be treated	▪ Sequential washing systems can be developed for soils with complex contaminant mixtures ▪ Generated contaminated water will require treatment ▪ Performed on-site	▪ Moderate capital costs ▪ Moderate O & M costs	Eliminated due to limited practicality on small volumes of contaminated soil and availability of more reliable and cost-effective options.
		Solvent Extraction	▪ Target contaminants include PCBs ▪ Reduces volume of soil that required treatment ▪ Also effective for PAHs and TPHs ▪ Acid extraction can be used to treat soils contaminated by heavy metals	▪ Batch process ▪ Treatability study required ▪ On-site prescreening required ▪ Monitoring required ▪ Construction of treatment cell ▪ Toxicity of solvent is an important consideration as it may remain in treated soils ▪ Residual solvent in treated soils may necessitate landfill disposal	▪ Moderate to high capital costs ▪ Moderate O & M costs	Eliminated due to high costs, residual solvent issues, and availability of other proven, effective treatment technologies.
Treatment Actions *(In-Situ)*	Thermal Treatment	Thermal Desorption	▪ Proven effective for PCBs in surface and subsurface soils ▪ Also effective for PAHs and TPH	▪ Requires more energy for wet and high organic soils ▪ Requires air permit ▪ Monitoring Required ▪ Requires electric hook-up (480 volts, 3 phase, 3 mega watts)	▪ Moderate to high capital costs ▪ Low O & M costs	Eliminated because high moisture content in soils will keep this alternative from being cost effective.

TABLE 3-4
FINAL REMEDIAL ACTION TECHNOLOGIES AND PROCESS OPTIONS
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Media	General Response Action	Remedial Action Technology Type	Process Option
Soil/Sediment	No Action	No Action	No Action
	Institutional Controls	Site Access Restrictions	Fencing, posting signs
		Land Use Restrictions	Deed restrictions
	Containment/Removal Actions	Capping	Clay/Soil Cap
		Excavation	Excavation
		Disposal	Landfill Disposal

TABLE 4-1
SOIL REMEDIAL ACTION ALTERNATIVE SUMMARY TABLE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Alternative	Description / Components	Appropriate Land Uses	Land Use Controls Needed	TPH Cleanup Level	PCB Cleanup Level	PAH/Pesticide Cleanup Level
RAA 1) No Action	No remedial action or institutional controls	None	None	NA	NA	NA
High-Occupancy Land Uses						
RAA 2) Excavation and Landfill Disposal ("No Access Restrictions")	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration	Housing, school, park, marina, office building	None	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	1 ppm	Residential PRGs
RAA 2a) Excavation and Landfill Disposal ("Access Restrictions")	Excavate all soils above cleanup levels in open areas; fence wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration	Housing, school, park, marina, office building	Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	1 ppm	Residential PRGs
RAA 3) Excavation and Capping ("No Access Restrictions")	Excavate all soils above 10 ppm PCBs; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding residential PRGs, TPH cleanup levels, or 1 ppm PCBs; site restoration; wetland restoration	Housing, school, park, marina, office building	Intrusive restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	10 ppm (excavation) 1 ppm (capping)	Residential PRGs (capping)
RAA 3a) Excavation and Capping ("Access Restrictions")	Excavate all soils above 10 ppm PCBs in open areas; fence wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding residential PRGs; TPH cleanup levels, and exceeding 1 ppm PCBs; site restoration	Housing, school, park, marina, office building	Intrusive restrictions, Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	10 ppm (excavation) 1 ppm (capping)	Residential PRGs (capping)
Low-Occupancy Land Uses						
RAA 4) Excavation and Landfill Disposal	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	10 ppm	Residential PRGs
RAA 5) Hot Spot Removal and Institutional Controls	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	25 ppm	Industrial PRGs
RAA 6) Hot Spot Removal and Fencing	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	50 ppm	Industrial PRGs
RAA 7) Hot Spot Removal and Capping	Excavate all soils above 100 ppm PCBs; disposal of TSCA and non-TSCA waste in appropriate landfills; cap soils exceeding industrial PRGs, TPH cleanup levels, or 25 ppm PCBs; site restoration; site perimeter fencing	Non-office warehouse, equipment storage, electrical substation	Land use restrictions, Intrusive restrictions Site access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO) (capping)	100 ppm (excavation) 25 ppm (capping)	Industrial PRGs (capping)
Recreational Land Uses						
RAA 8) Excavation and Landfill Disposal ("No Access Restrictions")	Excavate all soils above cleanup levels; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration; wetland restoration	Marina, fishing, boating, community park	Land use restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	7.7 ppm	Risk-based goals (see Table 2-14)
RAA 8a) Excavation and Landfill Disposal ("Access Restrictions")	Excavate all soils above cleanup levels in open areas; fence wooded/wetland areas; disposal of TSCA and non-TSCA waste in appropriate landfills; site restoration	Marina, fishing, boating, community park	Land use restrictions, Partial access restrictions	10 ppm - TPH(GRO) 40 ppm - TPH(DRO)	7.7 ppm	Risk-based goals (see Table 2-14)

TABLE 4-2
GROUNDWATER REMEDIAL ACTION ALTERNATIVE SUMMARY TABLE
OPERABLE UNIT NO. 19, SITE 84/BUILDING 45 AREA
FEASIBILITY STUDY, CTO-0219
MCB CAMP LEJEUNE, NORTH CAROLINA

Alternative	Description / Components	Land Use Controls Needed
GW-RAA 1) No Action	No remedial action or institutional controls	None
GW-RAA 2) Groundwater Monitoring and Institutional Controls	Groundwater monitoring of representative site monitoring wells to evaluate metals/pesticides constituents. Implementation of aquifer use restrictions.	Aquifer use restrictions Intrusive restrictions

TABLE 5-1
RAA 2 - EXCAVATION AND LANDFILL DISPOSAL (HIGH-OCCUPANCY LAND USE, NO ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Clearing and Grubbing (Wetlands and Wooded Area)	1.5	AC	$5,675	$8,513	Means Site Work 2001 (02230-200-0260)
C. Contaminated Stormwater Management	1	LS	$10,000	$10,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
D. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
E. Erosion Protection	1	LS	$10,000	$10,000	Engineering Estimate
F. Wetland Boundary Delineation	1	LS	$5,000	$5,000	Engineering Estimate
G. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$52,013	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil [2]	7600	CY	$3.43	$26,062	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Solidified Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Excavation of Wetland Soils	600	CY	$11.56	$6,939	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D Wetland soils will be spread over upland areas for dewatering
E. Confirmatory Sampling [3]	400	EA	$580	$232,000	Analysis for SVOCs, PCBs/Pesticides& TPH. Includes $50/sample for collection/handling. Assume 100 samples/acre.
F. Base Landfill Disposal (PCBs < 50 ppm)	12168	Ton	$5	$60,788	Transport to Base Landfill, distance of 4 miles each way (estimate)
G. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
H. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$10,000	$10,000	11 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
J. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
K. Backfill (bring site to within 6" of original grade)	5023	CY	$16.30	$81,880	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
L. Top Soil (6-inches)	3227	CY	$30.00	$96,800	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
M. Fine Grading/Stormwater Controls	4.5	AC	$2,800	$12,600	Means Site Work (02300-440-0100)
N. Restoration of Wetlands	0.4	AC	$100,000	$40,000	Engineering Estimate
O. Revegetation	4.1	AC	$2,500	$10,250	Engineering Estimate
N. Fencing (8' chain-link fence)	910	LF	$31	$28,210	Means Site Work 2001 (02820-528-0920)
Subtotal				$718,759	
Subtotal - Direct Capital Costs				$770,772	
Scope & Bid Contingency				$269,770	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$1,040,542**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$124,865	$124,865	Assume 12% of total direct capital cost
II. Construction Management	1	LS	$83,243	$83,243	Assume 8% of total direct capital cost
III. Project Management	1	LS	$62,433	$62,433	Assume 6% of total direct capital cost
TOTAL - PROFESSIONAL SERVICES COSTS				**$270,541**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$1,040,542	
PROFESSIONAL SERVICES COSTS				$270,541	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$1,311,083**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Wetland soils to be spread over the contaminated upland area for dewatering are included in excavation quantity due to the double handling of material required.
(3) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-2
RAA 2a - EXCAVATION AND LANDFILL DISPOSAL (HIGH-OCCUPANCY LAND USE, ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
Marine Corps Base, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$5,000	$5,000	Engineering Estimate
G. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$28,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	5700	CY	$3.43	$19,547	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Confirmatory Sampling [2]	300	EA	$580	$174,000	Analysis for SVOCs, PCBs/Pesticides& TPH. Includes $50/sample for collection/handling.
E. Base Landfill Disposal (PCBs < 50 ppm)	9308	Ton	$5	$46,538	Transport to Base Landfill, distance of 4 miles each way (estimate)
F. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
G. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$8,500	$8,500	8 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
I. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
J. Backfill (bring site within 6" of original grade)	4087	CY	$16.30	$66,611	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
K. Top Soil (6-inches)	2275	CY	$30.00	$68,264	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
L. Fine Grading/Stormwater Controls	3.5	AC	$2,800	$9,800	Means Site Work (02300-440-0100)
M. Revegetation	3.5	AC	$2,500	$8,750	Engineering Estimate
N. Fencing (8' chain-link fence)	1570	LF	$31	$48,670	Means Site Work 2001 (02820-528-0920)
Subtotal				$563,909	
Subtotal - Direct Capital Costs				$592,409	
Scope & Bid Contingency				$207,343	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$799,752**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$95,970	$95,970	Assume 12% of total direct capital cost
II. Construction Management	1	LS	$63,980	$63,980	Assume 8% of total direct capital cost
III. Project Management	1	LS	$47,985	$47,985	Assume 6% of total direct capital cost
IV. Institutional Controls	1	LS	$5,000	$5,000	Partial access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$212,936**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$799,752	
PROFESSIONAL SERVICES COSTS				$212,936	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$1,012,688**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-3
RAA 3 - EXCAVATION AND CAPPING (HIGH-OCCUPANCY LAND USE, NO ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
Marine Corps Base, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Clearing and Grubbing (Wetlands and Wooded Area)	1.3	AC	$5,675	$7,378	Means Site Work 2001 (02230-200-0260)
C. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
D. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
E. Erosion Protection	1	LS	$10,000	$10,000	Engineering Estimate
F. Wetland Boundary Delineation	1	LS	$5,000	$5,000	Engineering Estimate
G. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$45,878	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	3200	CY	$3.43	$10,974	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyahs, lime, or cement)
C. Excavation of Solidified Lagoon Sediments	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Excavation of Wetland Soils	1	LS	$5,000	$5,000	One isolated hit in wetlands. Assume to be excavated & spread over contaminated upland areas for capping. Cost includes access road & addt'l soil handling.
E. Confirmatory Sampling [2]	170	EA	$115	$19,550	Analysis for PCBs. Includes $50/sample for collection/handling.
F. Base Landfill Disposal (PCBs < 50 ppm)	5558	Ton	$5	$27,788	Transport to Base Landfill, distance of 4 miles each way (estimate)
G. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
H. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$7,000	$7,000	5 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
J. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
K. Backfill (bring site back to original grade plus 12" soil cap)	9896	CY	$16.30	$161,308	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
L. Top Soil (6 inches)	3181	CY	$30.00	$95,433	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
M. Fine Grading/Stormwater Controls	4.7	AC	$2,800	$13,160	Means Site Work (02300-440-0100)
N. Restoration of Wetlands	0.3	AC	$100,000	$30,000	Engineering Estimate
O. Revegetation	4.4	AC	$2,500	$11,000	Engineering Estimate
P. Fencing (8' chain-link fence)	910	LF	$31	$28,210	Means Site Work 2001 (02820-528-0920)
Subtotal				$522,652	
Subtotal - Direct Capital Costs				$568,530	
Scope & Bid Contingency				$198,985	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$767,515**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$115,127	$115,127	Assume 15% of total direct capital cost
II. Construction Management	1	LS	$76,751	$76,751	Assume 10% of total direct capital cost
III. Project Management	1	LS	$61,401	$61,401	Assume 8% of total direct capital cost - includes deed restrictions
IV. Institutional Controls	1	LS	$5,000	$5,000	Intrusive restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$258,280**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$767,515	
PROFESSIONAL SERVICES COSTS				$258,280	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$1,025,795**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-4
RAA 3a - EXCAVATION AND CAPPING (HIGH-OCCUPANCY LAND USE, ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$5,000	$5,000	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$28,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	2700	CY	$3.43	$9,259	Means Site Work 2001 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyahs, lime, or cement)
C. Excavation of Solidified Lagoon Sediments	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Confirmatory Sampling [2]	136	EA	$115	$15,640	Analysis for PCBs. Includes $50/sample for collection/handling.
E. Base Landfill Disposal (PCBs <50 ppm)	4808	Ton	$5	$24,038	Transport to Base Landfill, distance of 4 miles each way (estimate)
F. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
G. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$6,500	$6,500	4 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
I. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
J. Backfill (bring site back to original grade plus 12" soil cap)	8112	CY	$16.30	$132,223	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
K. Top Soil (6 Inches)	2568	CY	$30.00	$77,052	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
L. Fine Grading/Stormwater Controls	3.7	AC	$2,800	$10,360	Means Site Work (02300-440-0100)
M. Revegetation	3.7	AC	$2,500	$9,250	Engineering Estimate
N. Fencing (8' chain-link fence)	1570	LF	$31	$48,670	Means Site Work 2001 (02820-528-0920)
Subtotal				$446,222	
Subtotal - Direct Capital Costs				$474,722	
Scope & Bid Contingency				$166,153	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$640,874**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$96,131	$96,131	Assume 15% of total direct capital cost
II. Construction Management	1	LS	$64,087	$64,087	Assume 10% of total direct capital cost
III. Project Management	1	LS	$51,270	$51,270	Assume 8% of total direct capital cost
IV. Institutional Controls	1	LS	$10,000	$10,000	Intrusive and partial access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$221,489**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$640,874	
PROFESSIONAL SERVICES COSTS				$221,489	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$862,363**	

Notes:

(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.

(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-5
RAA 4 - EXCAVATION AND LANDFILL DISPOSAL (LOW-OCCUPANCY LAND USE)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$5,000	$5,000	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$28,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	3650	CY	$3.43	$12,517	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Confirmatory Sampling [2]	150	EA	$580	$87,000	Analysis for SVOCs, PCBs/Pesticides& TPH. Includes $50/sample for collection/handling. Assume 100 samples/acre.
E. Base Landfill Disposal (PCBs < 50 ppm)	6233	Ton	$5	$31,163	Transport to Base Landfill, distance of 4 miles each way (estimate)
F. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
G. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
H. Analytical/Waste Profiles for Off-site Disposal	1	LS	$6,500	$6,500	4 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
I. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
J. Backfill (bring site back to within 6 inches of original grade)	2800	CY	$16.30	$45,640	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
K. Top Soil (6-inches)	1500	CY	$30.00	$45,000	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
L. Fine Grading/Stormwater Controls	2	AC	$2,800	$5,600	Means Site Work (02300-440-0100)
M. Revegetation	2	AC	$2,500	$5,000	Engineering Estimate
N. Fencing (8' chain-link fence)	2210	LF	$31	$68,510	Means Site Work 2001 (02820-528-0920)
Subtotal				$420,160	
Subtotal - Direct Capital Costs				$448,660	
Scope & Bid Contingency				$157,031	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$605,691**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$90,854	$90,854	Assume 15% of total direct capital cost
II. Construction Management	1	LS	$60,569	$60,569	Assume 10% of total direct capital cost
III. Project Management	1	LS	$48,455	$48,455	Assume 8% of total direct capital cost
IV. Institutional Controls	1	LS	$15,000	$15,000	Land use, intrusive, and site access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$214,878**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$605,691	
PROFESSIONAL SERVICES COSTS				$214,878	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$820,568**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-6
RAA 5 - HOT SPOT REMOVAL AND INSTITUTIONAL CONTROLS (LOW-OCCUPANCY LAND USE)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$5,000	$5,000	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$28,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	3100	CY	$3.43	$10,631	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Confirmatory Sampling [2]	150	EA	$580	$87,000	Analysis for SVOCs, PCBs/Pesticides& TPH. Includes $50/sample for collection/handling. Assume 100 samples/acre.
E. Base Landfill Disposal (PCBs < 50 ppm)	5408	Ton	$5	$27,038	Transport to Base Landfill, distance of 4 miles each way (estimate)
F. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
G. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
H. Analytical/Waste Profiles for Off-site Disposal	1	LS	$6,500	$6,500	4 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
I. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
J. Backfill (bring site back to within 6 inches of original grade)	2561	CY	$16.30	$41,741	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
K. Top Soil (6-inches)	1189	CY	$30.00	$35,676	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
L. Fine Grading/Stormwater Controls	2	AC	$2,800	$5,600	Means Site Work (02300-440-0100)
M. Revegetation	2	AC	$2,500	$5,000	Engineering Estimate
N. Fencing (8' chain-link fence)	2210	LF	$31	$68,510	Means Site Work 2001 (02820-528-0920)
Subtotal				$400,926	
Subtotal - Direct Capital Costs				$429,426	
Scope & Bid Contingency				$150,299	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$579,725**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$86,959	$86,959	Assume 15% of total direct capital cost
II. Construction Management	1	LS	$57,972	$57,972	Assume 10% of total direct capital cost
III. Project Management	1	LS	$46,378	$46,378	Assume 8% of total direct capital cost
IV. Institutional Controls	1	LS	$15,000	$15,000	Land use, intrusive, and site access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$206,309**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$579,725	
PROFESSIONAL SERVICES COSTS				$206,309	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$786,034**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-7
RAA 6 - HOT SPOT REMOVAL AND FENCING (LOW-OCCUPANCY LAND USE)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$2,500	$2,500	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$2,500	$2,500	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$23,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	900	CY	$3.43	$3,086	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Confirmatory Sampling [2]	25	EA	$1,210	$30,250	Analysis for SVOCs, PCBs/Pesticides& TPH-double cost for quick turn. Includes $50/sample for collection/handling. Assume 100 samples/acre.
D. Base Landfill Disposal (PCBs < 50 ppm)	1058	Ton	$5	$5,288	Transport to Base Landfill, distance of 4 miles each way (estimate)
E. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
F. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$5,000	$5,000	1 sample (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
H. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
I. Backfill (bring site to within 6" of original grade)	1004	CY	$16.30	$16,370	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
J. Top Soil (6-inches)	196	CY	$30.00	$5,871	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
K. Fine Grading/Stormwater Controls	1	AC	$2,800	$2,800	Means Site Work (02300-440-0100)
L. Revegetation	1	AC	$2,500	$2,500	Engineering Estimate
M. Fencing (8' chain-link fence)	2210	LF	$31	$68,510	Means Site Work 2001 (02820-528-0920)
Subtotal				$244,810	
Subtotal - Direct Capital Costs				$268,310	
Scope & Bid Contingency				$93,908	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$362,218**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$72,444	$72,444	Assume 20% of total direct capital cost
II. Construction Management	1	LS	$54,333	$54,333	Assume 15% of total direct capital cost
III. Project Management	1	LS	$36,222	$36,222	Assume 10% of total direct capital cost
IV. Institutional Controls	1	LS	$15,000	$15,000	Land use, intrusive, and site access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$177,998**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$362,218	
PROFESSIONAL SERVICES COSTS				$177,998	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$540,217**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-8
RAA 7 - HOT SPOT REMOVAL AND CAPPING (LOW-OCCUPANCY LAND USE)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
Marine Corps Base, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$2,500	$2,500	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$2,500	$2,500	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$23,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil (>100 ppm PCBs)	30	CY	$3.43	$103	Means Site Work 2001 (02315-400-1250) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyahs, lime, or cement)
C. Confirmatory Sampling [2]	10	EA	$180	$1,800	PCB analysis-double cost for quick turn. Include $50/sample for collection/handling.
D. Off-Site Landfill Disposal (PCBs > 50 ppm)	45	Ton	$112	$5,040	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
E. Off-Site Landfill Transport. (PCBs > 50 ppm)	45	Ton	$110	$4,950	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$1,500	$1,500	1 TCLP (TSCA landfill) @ $1500/ea
G. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
H. Backfill (bring site back to original grade plus 12" soil cap)	2587	CY	$16.30	$42,163	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
I. Top Soil (6 inches)	1147	CY	$30.00	$34,420	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
J. Fine Grading/Stormwater Controls	2	AC	$2,800	$5,600	Means Site Work (02300-440-0100)
K. Revegetation	2	AC	$2,500	$5,000	Engineering Estimate
L. Fencing (8' chain-link fence)	2210	LF	$31	$68,510	Means Site Work 2001 (02820-528-0920)
Subtotal				$209,286	
Subtotal - Direct Capital Costs				$232,786	
Scope & Bid Contingency				$81,475	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$314,260**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$78,565.12	$78,565	Assume 25% of total direct capital cost
II. Construction Management	1	LS	$62,852.10	$62,852	Assume 20% of total direct capital cost
III. Project Management	1	LS	$47,139.07	$47,139	Assume 15% of total direct capital cost
IV. Institutional Controls	1	LS	$15,000	$15,000	Land use, intrusive, and site access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$203,556**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$314,260	
PROFESSIONAL SERVICES COSTS				$203,556	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$517,817**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-9
RAA 8 - EXCAVATION AND LANDFILL DISPOSAL (RECREATIONAL LAND USE, NO ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
MCB, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Clearing and Grubbing (Wetlands and Wooded Area)	1	AC	$5,675	$5,675	Means Site Work 2001 (02230-200-0260)
C. Contaminated Stormwater Management	1	LS	$10,000	$10,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
D. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
E. Erosion Protection	1	LS	$10,000	$10,000	Engineering Estimate
F. Wetland Boundary Delineation	1	LS	$5,000	$5,000	Engineering Estimate
G. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$49,175	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil [2]	7200	CY	$3.43	$24,691	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Solidified Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Excavation of Wetland Soils	300	CY	$11.56	$3,469	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D. Wetland soils will be spread over upland areas for dewatering
E. Confirmatory Sampling [3]	350	EA	$580	$203,000	Analysis for SVOCs, PCBs/Pesticides & TPH. Includes $50/sample for collection/handling. Assume 100 samples/acre.
F. Base Landfill Disposal (PCBs < 50 ppm)	11,558	Ton	$5	$57,788	Transport to Base Landfill, distance of 4 miles each way (estimate)
G. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
H. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$10,000	$10,000	11 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
J. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
K. Backfill (bring site to within 6" of original grade)	5027	CY	$16.30	$81,935	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
L. Top Soil (6-inches)	2823	CY	$30.00	$84,700	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
M. Fine Grading/Stormwater Controls	4	AC	$2,800	$11,200	Means Site Work (02300-440-0100)
N. Restoration of Wetlands	0.15	AC	$100,000	$15,000	Engineering Estimate
O. Revegetation	3.6	AC	$2,500	$9,000	Engineering Estimate
P. Fencing (8' chain-link fence)	910	LF	$31	$28,210	Means Site Work 2001 (02820-528-0920)
Subtotal				$642,223	
Subtotal - Direct Capital Costs				$691,398	
Scope & Bid Contingency				$241,989	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$933,387**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$112,006	$112,006	Assume 12% of total direct capital cost
II. Construction Management	1	LS	$74,671	$74,671	Assume 8% of total direct capital cost
III. Project Management	1	LS	$56,003	$56,003	Assume 6% of total direct capital cost
IV. Institutional Controls	1	LS	$5,000	$5,000	Land Use Restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$247,681**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$933,387	
PROFESSIONAL SERVICES COSTS				$247,681	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$1,181,067**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Wetland soils to be spread over the contaminated upland area for dewatering are included in excavation quantity due to the double handling of material required.
(3) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-10
RAA 8a - EXCAVATION AND LANDFILL DISPOSAL (RECREATIONAL LAND USE, ACCESS RESTRICTIONS)
BUDGETARY COST ESTIMATE [1]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
Marine Corps Base, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Site Preparation					
A. Mobilization/Demobilization	1	LS	$15,000	$15,000	Engineering Judgement
B. Contaminated Stormwater Management	1	LS	$5,000	$5,000	Includes collection, sampling, pumping, and transport to Lot 203 treatment plant
C. Grouting of Pipe and Inlet Removal / Disposal	1	LS	$1,000	$1,000	Engineering Estimate - grout 40 feet of 12-inch diameter pipe with concrete
D. Erosion Protection	1	LS	$5,000	$5,000	Engineering Estimate
E. Rails-to-Trails ROW Investigation	1	LS	$2,500	$2,500	Engineering Estimate
Subtotal				$28,500	
II. Excavation and Site Restoration					
A. Excavation of Contaminated Soil	5500	CY	$3.43	$18,861	Means Site Work 2002 (02315-400-1200) (02315-400-0020) Add 10% for Level D
B. Solidification of Lagoon Sediments	350	CY	$100.00	$35,000	Engineering Estimate (mix with flyash, lime, or cement)
C. Excavation of Sediments from Lagoon	700	CY	$11.56	$8,095	Means Site Work 2001 (02315-400-0550) (02315-400-0020) Add 10% for Level D
D. Confirmatory Sampling [2]	290	EA	$580	$168,200	Analysis for SVOCs, PCBs/Pesticides& TPH. Includes $50/sample for collection/handling.
E. Base Landfill Disposal (PCBs < 50 ppm)	9008	Ton	$5	$45,038	Transport to Base Landfill, distance of 4 miles each way (estimate)
F. Off-Site Landfill Disposal (PCBs > 50 ppm)	293	Ton	$112	$32,760	Vendor Quote: Disposal Fee plus local and state taxes - Model City, NY
G. Off-Site Landfill Transport. (PCBs > 50 ppm)	293	Ton	$110	$32,175	Vendor Quote (From Camp Lejeune to Model City, NY)
I. Analytical/Waste Profiles for Off-site Disposal	1	LS	$8,500	$8,500	8 samples (Base landfill) @ $500/ea plus 3 TCLP (TSCA landfill) @ $1500/ea
I. Decontamination Of Equipment	1	LS	$5,200	$5,200	Engineering Estimate Environmental Means 2001 (19-04-0626)
J. Backfill (bring site within 6" of original grade)	3891	CY	$16.30	$63,429	Means Site Work 2001 (02320-200-0540) (A12.1-724-1550), Assume source is on-Base borrow area, includes placement/compaction
K. Top Soil (6-inches)	2259	CY	$30.00	$67,760	Means Site Work 2001 (02315-200-7010) (02320-200-0540) (A12.1-724-1550)
L. Fine Grading/Stormwater Controls	3.4	AC	$2,800	$9,520	Means Site Work (02300-440-0100)
M. Revegetation	3.4	AC	$2,500	$8,500	Engineering Estimate
N. Fencing (8' chain-link fence)	1570	LF	$31	$48,670	Means Site Work 2001 (02820-528-0920)
Subtotal				$551,708	
Subtotal - Direct Capital Costs				$580,208	
Scope & Bid Contingency				$203,073	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$783,280**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$93,994	$93,994	Assume 12% of total direct capital cost
II. Construction Management	1	LS	$62,662	$62,662	Assume 8% of total direct capital cost
III. Project Management	1	LS	$46,997	$46,997	Assume 6% of total direct capital cost
IV. Institutional Controls	1	LS	$10,000	$10,000	Land Use Restrictions, Partial access restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$213,653**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$783,280	
PROFESSIONAL SERVICES COSTS				$213,653	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$996,933**	

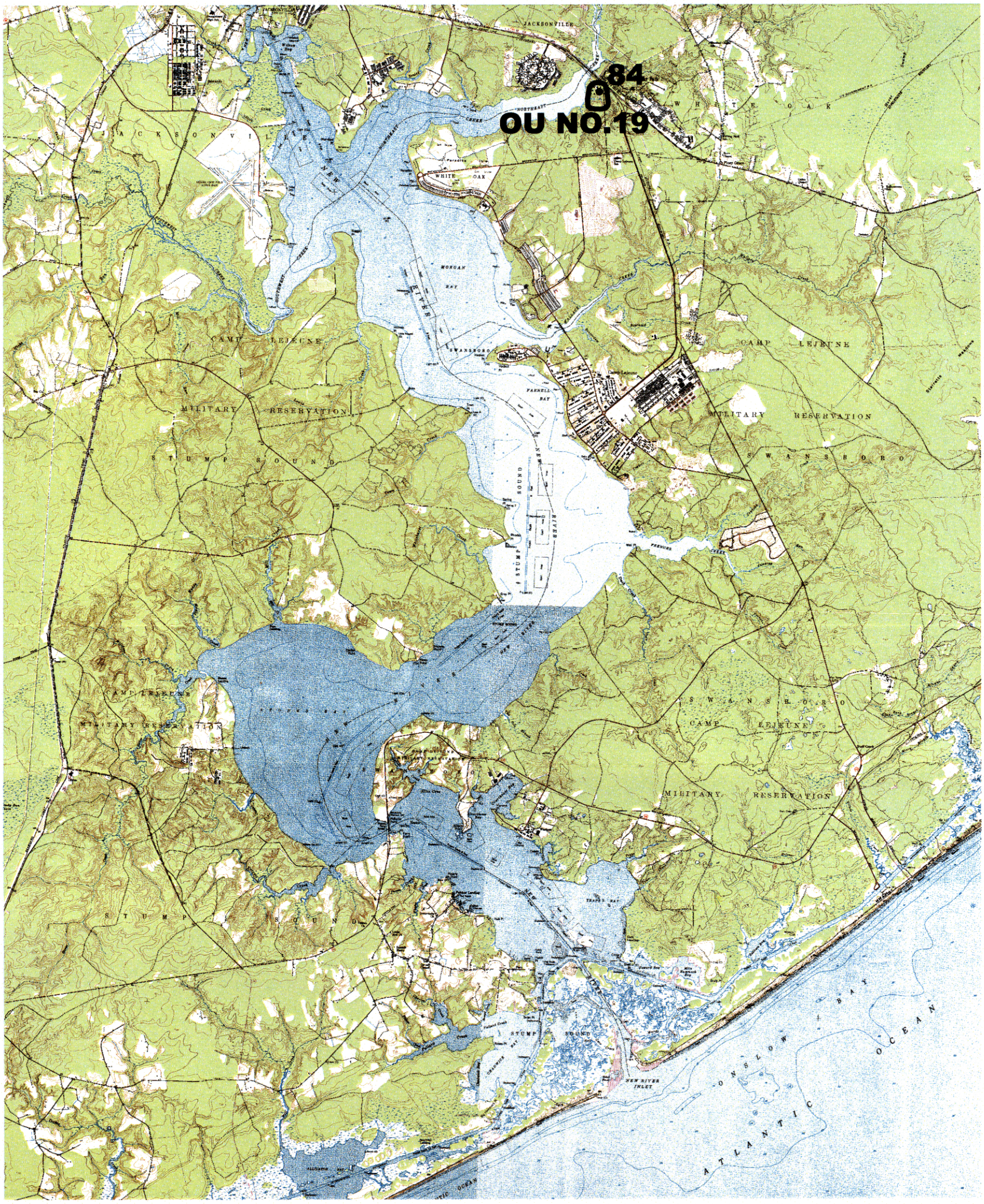
Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Confirmatory Sampling will be conducted on a 25' by 25' grid on the bottom of the excavation and at 25' spacing along the side walls (assume 100 samples/acre).

TABLE 5-11
GW RAA 2 - GROUNDWATER MONITORING AND INSTITUTIONAL CONTROLS
BUDGETARY COST ESTIMATE [1][2]
Operable Unit No. 19, Site 84/Building 45 Area
Feasibility Study CTO-0219
Marine Corps Base, Camp Lejeune, North Carolina

Cost Item	Quantity	Units	Unit Cost	Total Cost	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS					
I. Groundwater Monitoring					
A. Mob/travel	4	events	$2,500	$10,000	Engineering Judgement
B. Groundwater sampling - labor	4	events	$2,400	$9,600	2 technicians @ $40/hr; 10 hrs/day for 3 days
C. Analytical Costs	4	events	$3,035	$12,140	16 inorganics + 4 VOCs + 2 pesticides + QA/QC samples/per event
D. Miscellaneous direct costs	4	events	$500	$2,000	sample shipping, field supplies, etc.
E. Reporting	1	report	$5,000	$5,000	Engineering Estimate
Subtotal - Direct Capital Costs				$38,740	
Scope & Bid Contingency				$13,559	Total 35% contingency (20% scope and 15% bid contingency)
TOTAL - DIRECT CAPITAL COSTS				**$52,300**	
PROFESSIONAL SERVICES					
I. Design/Engineering Support	1	LS	$0	$0	None required - reporting cost included above
II. Construction Management	1	LS	$0	$0	None required
III. Project Management	1	LS	$10,000	$10,000	Professional Judgement
IV. Institutional Controls	1	LS	$5,000	$5,000	Aquifer use restrictions
TOTAL - PROFESSIONAL SERVICES COSTS				**$15,000**	
ANNUAL OPERATION & MAINTENANCE COSTS					
TOTAL - ANNUAL O&M COSTS				**$0**	
TOTAL PROJECT COST SUMMARY					
DIRECT CAPITAL COSTS				$52,300	
PROFESSIONAL SERVICES COSTS				$15,000	
PRESENT WORTH OF ANNUAL O&M COSTS				$0	
TOTAL PROJECT COST				**$67,300**	

Notes:
(1) Estimated accuracy of cost estimate is -30% to +50%. Cost estimate is to be used primarily for comparison of costs relative to other response action alternatives.
(2) Cost estimate assumes that only four sampling events will be required (I.e., long-term monitoring will not be required).

FIGURES



0 84
OU NO.19

8000 0 4000 8000
1 inch = 8000 ft.

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2219507F

LEGEND

SOURCE: U.S.G.S. QUADRANGLES JACKSONVILLE SOUTH, CAMP LEJEUNE, SNEADS FERRY AND NEW RIVER INLET.

FIGURE 1-1
SITE LOCATION MAP
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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NORTHEAST CREEK

FLOW

500-YEAR FLOOD PLAIN

WETLANDS

NWI MAPS

CAMP LEJEUNE DATABASE

LAGOON

PIPE OUTLET

PIPE

DRAINAGE INLET

DIRT ROAD

N.C. HWY 24

RAILROAD

DRAINAGE INLET

PIPE OUTLET

PIPE OUTLET

GRAVEL ROAD

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

FORMER AST S781

2 EXISTING VEHICLE GATES AND FENCE

BUILDING 45 FOUNDATION

780

CP&L SUBSTATION

LCH216

LCH214

LCH116

LCH114

LCH112

LCH110

LCH115

LCH108

LCH106

LCH113

LCH111

LCH109

LCH107

LCH105

120 0 60 120

1 inch = 120 ft.

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LEGEND

- GRAVEL ROAD
- FORMER BUILDING
- FENCE
- RAIL ROAD
- INTERMITTENT DRAINAGE SWALE
- APPROXIMATE WETLAND BOUNDARY
- TREE LINE
- TREE
- WETLANDS

FIGURE 1-2
SITE FEATURES MAP
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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NORTHEAST CREEK

MW-23 2.03

N.C. HWY 24

RAILROAD

DRAINAGE INLET

DRAINAGE INLET

PIPE

PIPE OUTLET

FLOW

EDGE OF BANK

MW-7/MW-8

MW-20 3.18

PIPE OUTLET

PIPE

LAGOON

PIPE OUTLET

DIRT ROAD

GRAVEL ROAD

FORMER AST S781

MW-16 4.97

MW-22 4.74

MW-17 5.86*

2 EXISTING VEHICLE GATES AND FENCE

500-YEAR FLOOD PLAIN

WETLANDS

BUILDING FOUNDATION

45

MW-19 4.38

MW-21 12.06

MW-18 15.05

780

CP&L SUBSTATION

MW-09 MW-10 2.65

LCH216 LCH214 LCH116 LCH114 LCH112 LCH110 LCH115 LCH108 LCH106 LCH113 LCH111 LCH109 LCH107 LCH105

120 0 60 120

1 inch = 120 ft.

Baker

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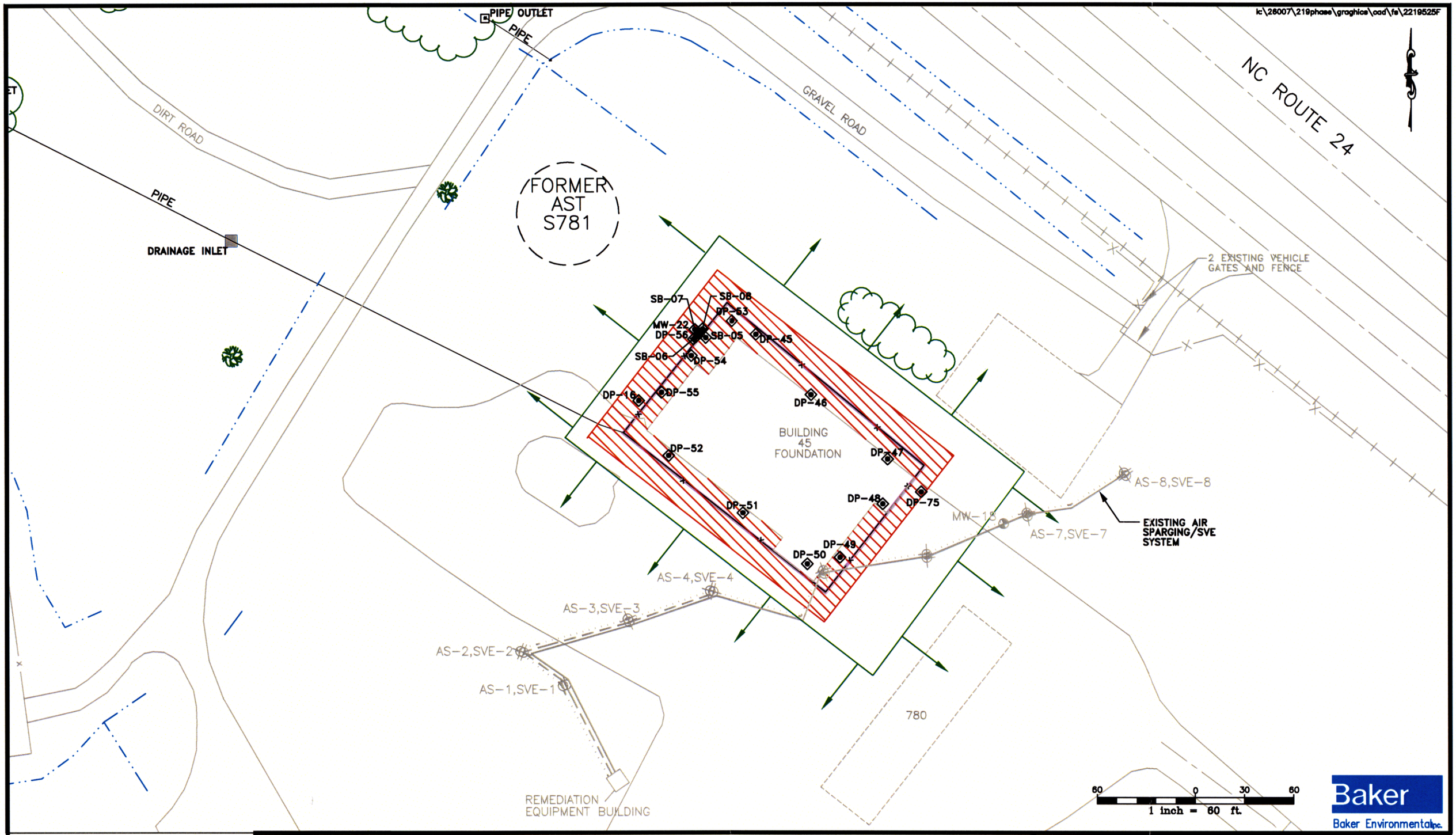
LEGEND

- EXISTING MONITORING WELL (1992)
- NEW MONITORING WELL (2001)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
-14- GROUNDWATER ELEVATION (FT. ABOVE, MSL)

NOTE:
* GROUNDWATER ELEVATIONS FROM MW-17 WERE NOT USED DURING GROUNDWATER CONTOUR CALCULATIONS

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- WETLANDS
- TREE
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

FIGURE 1-3
GROUNDWATER CONTOUR MAP
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- FORMER BUILDING
- FENCE
- RAIL ROAD
- TREE
- MINIMUM EXCAVATION AREA REQUIRED FOR SAFE FOUNDATION REMOVAL TO BE ESTABLISHED BY RAC (COULD VARY BETWEEN 1:1 AND 2:1)
- FENCE TO BE REMOVED
- LIMITS OF EXCAVATION (NO EXCAVATION TO BE DONE BEYOND THIS LIMIT)
- DIRECT PUSH SOIL BORING (2001)

FIGURE 1-4
SOIL EXCAVATION AREA, NON-TCRA
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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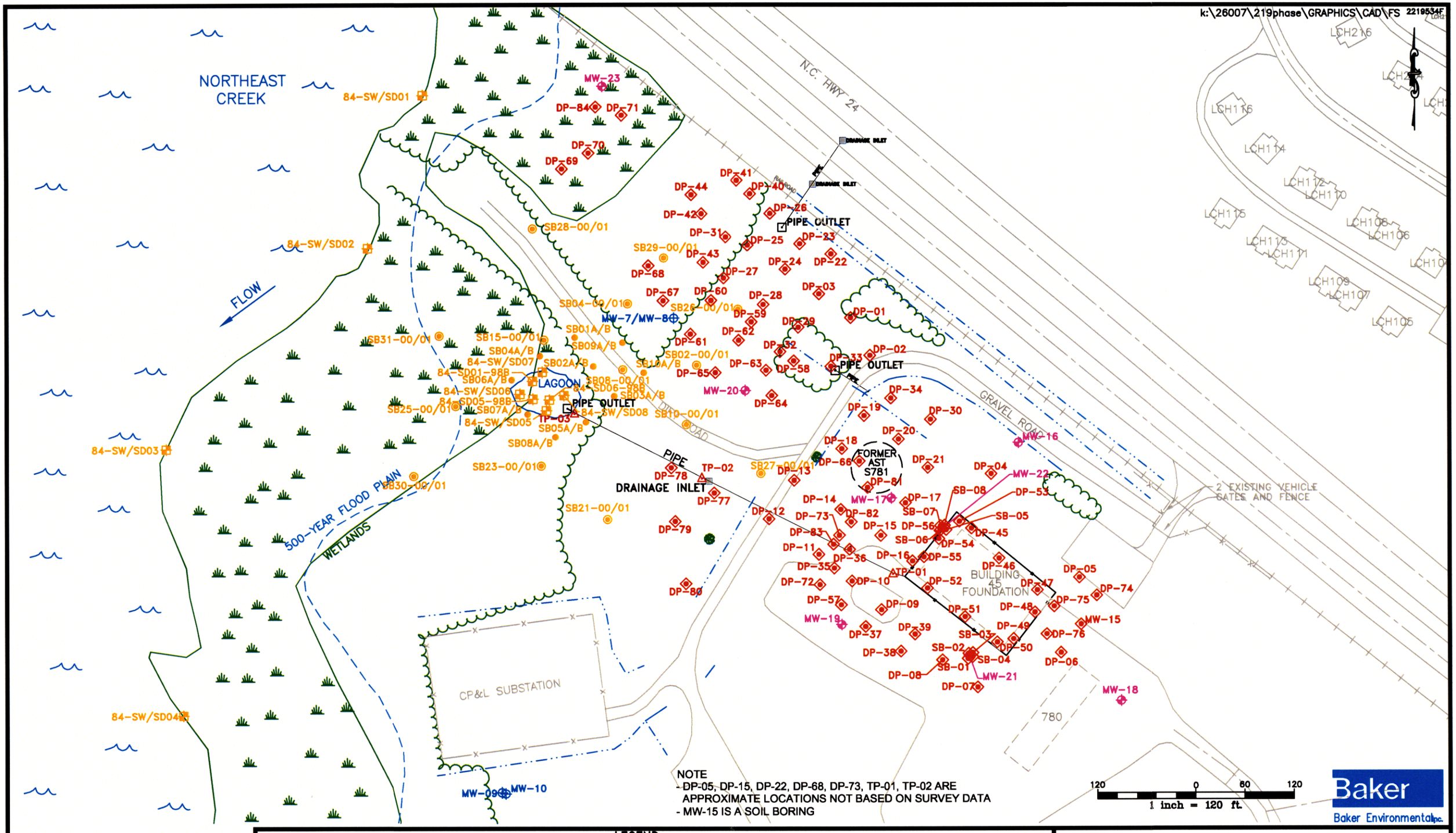

NOTE
- DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING

120 0 60 120
1 inch = 120 ft.

Baker
Baker Environmental, Inc.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SURFACE WATER/SEDIMENT SAMPLE STATION (1995/1998)
- SOIL SAMPLING LOCATION (1995)

FIGURE 1-5
SAMPLE LOCATIONS MAP
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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NOTES:
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
-CONCENTRATIONS IN RED TYPE EXCEED NORTH CAROLINA STATE UST CLEANUP GOALS.

N.C. HWY 24
RAILROAD
DRAINAGE INLET
DRAINAGE INLET
PIPE
PIPE OUTLET
PIPE OUTLET
PIPE
GRAVEL ROAD
DIRT ROAD
PIPE
DRAINAGE INLET
FLOW
500-YEAR FLOOD PLAIN
WETLANDS
PIPE OUTLET
2 EXISTING VEHICLE GATES AND FENCE
FORMER AST S781
BUILDING 45 FOUNDATION
CP&L SUBSTATION
780
1,500

MW-23 DP-84 DP-71 DP-70 DP-69 DP-41 DP-44 DP-40 DP-42 DP-26 DP-31 DP-25 DP-23 DP-43 DP-24 DP-22 DP-68 DP-27 DP-67 DP-60 DP-28 DP-03 DP-59 DP-01 DP-62 DP-61 DP-02 DP-63 DP-58 DP-65 DP-34 MW-20 DP-64 DP-19 DP-30 DP-20 DP-18 DP-66 DP-21 DP-04 MW-16 DP-81 DP-17 SB-08 MW-22 DP-53 DP-14 DP-82 MW-17 SB-07 SB-05 DP-15 DP-56 DP-83 DP-45 SB-06 DP-54 DP-11 DP-36 DP-16 DP-55 DP-35 DP-46 DP-05 DP-72 DP-10 DP-52 DP-47 DP-74 DP-57 DP-09 DP-51 DP-48 DP-75 MW-18 DP-49 MW-15 DP-37 DP-39 SB-03 DP-76 DP-38 SB-02 DP-50 SB-04 DP-06 DP-08 SB-01 MW-21 DP-07 MW-18 DP-80 MW-09 MW-10 DP-78 DP-77 DP-12 DP-79 SB21-00/01 SB23-00/01 SB30-00/01 SB25-00/01 SB31-00/01 SB15-00/01 SB04A/B SB02A/B SB06A/B SB01A/B SB09A/B SB08-00/01 SB03A/B SB07A/B SB05A/B SB08A/B TP-03 SB10-00/01 SB04-00/01 SB26-00/01 MW-7/MW-8 SB02-00/01 SB10A/B SB28-00/01 SB29-00/01 DP-68 DP-67 DP-60 DP-59 DP-62 DP-61 DP-63 DP-65 MW-20 DP-64 TP-02 SB27-00/01 DP-73 DP-78 DP-77 DP-79 DP-80 DP-12 DP-14 DP-75 DP-82 DP-83 DP-11 DP-36 DP-35 DP-72 DP-57 DP-10 DP-09 MW-18 DP-37 DP-38 DP-08 DP-07 DP-39 DP-52 DP-51 DP-48 DP-49 DP-50 SB-01 SB-02 SB-03 SB-04 MW-21 DP-56 SB-06 DP-54 DP-55 DP-46 DP-47 DP-75 DP-74 DP-05 DP-06 DP-76 MW-15 MW-18 LCH116 LCH114 LCH112 LCH110 LCH115 LCH113 LCH111 LCH109 LCH1

SAMPLE ID	IR84-DP15-03
DEPTH	5 - 7
SAMPLE DATE	07-18-2001
TOTAL PETROLEUM HYDROCARBONS (ug/kg)	
Diesel Range Organics	5,500,000
Gasoline Range Organics	580,000

120 0 60 120
1 inch = 120 ft.

Baker
Baker Environmental, Inc.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 2-1
EXCEEDANCES OF TOTAL PETROLEUM HYDROCARBONS (TPH) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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SAMPLE ID	IR84-DP84-00
DEPTH	0 - 1
SAMPLE DATE	08-03-2001
SEMIVOLATILES (ug/kg)	
Benzo(a)anthracene	1,800 J

SAMPLE ID	IR84-DP82-00
DEPTH	0 - 1
SAMPLE DATE	08-05-2001
PESTICIDES (ug/kg)	
Dieldrin	52

SAMPLE ID	IR84-MW20-00
DEPTH	0 - 1
SAMPLE DATE	08-01-2001
PESTICIDES (ug/kg)	
Dieldrin	50 J

SAMPLE ID	84-MW17-00
DEPTH	0 - 1
SAMPLE DATE	07-31-2001
SEMIVOLATILES (ug/kg)	
Benzo(a)anthracene	5,900
Benzo(a)pyrene	5,800
Benzo(b)fluoranthene	7,100
Dibenz(a,h)anthracene	1,200 J
Indeno(1,2,3-cd)pyrene	3,200

NORTHEAST CREEK

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

N.C. HWY 24

RAILROAD

DRAINAGE INLET

PIPE OUTLET

GRAVEL ROAD

LAGOON

DRAINAGE DITCH

FORMER AST S781

EXISTING VEHICLE GATES AND FENCE

BUILDING 45 FOUNDATION

780

CP&L SUBSTATION

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF EPA REGION IX PRG RESIDENTIAL SOIL VALUES

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)

120 0 60 120
1 inch = 120 ft.

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Baker Environmental, Inc.

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

LEGEND
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 2-2
EXCEEDANCES OF RESIDENTIAL PRGs IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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SAMPLE ID	84-MW17-00
DEPTH	0 - 1
SAMPLE DATE	07-31-2001
SEMIVOLATILES (ug/kg)	
Benzo(a)anthracene	5,900
Benzo(a)pyrene	5,800
Benzo(b)fluoranthene	7,100
Dibenz(a,h)anthracene	1,200 J
Indeno(1,2,3-cd)pyrene	3,200

NORTHEAST CREEK

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

N.C. HWY 24

RAILROAD TRACK

DRAINAGE INLET

PIPE OUTLET

LAGOON

PIPE OUTLET

DITCH

ROAD

PIPE

DRAINAGE INLET

GRAVEL ROAD

2 EXISTING VEHICLE GATES AND FENCE

FORMER AST S781

MW-17

BUILDING 45 FOUNDATION

780

CP&L SUBSTATION

MW-23 DP-84 DP-71 DP-70 DP-69 DP-41 DP-44 DP-40 DP-42 DP-26 DP-31 DP-25 DP-23 DP-43 DP-24 DP-22 DP-68 DP-27 DP-67 DP-60 DP-28 DP-03 DP-59 DP-29 DP-01 DP-62 DP-61 DP-33 DP-02 DP-63 DP-58 DP-65 MW-20 DP-64 DP-34 DP-19 DP-30 DP-20 DP-18 DP-66 DP-21 DP-04 MW-22 DP-53 DP-14 DP-17 SB-08 SB-07 SB-05 DP-73 DP-82 DP-15 DP-56 DP-45 DP-83 SB-06 DP-54 DP-11 DP-36 DP-16 DP-55 DP-35 DP-46 DP-47 DP-72 DP-10 DP-52 DP-51 DP-48 DP-49 DP-57 DP-09 DP-75 DP-74 MW-19 DP-37 DP-39 SB-03 DP-76 MW-15 DP-38 SB-02 DP-50 SB-04 DP-06 DP-08 SB-01 MW-21 DP-07 MW-18 DP-79 DP-80 DP-77 DP-78 DP-12 TP-02 SB27-00/01 SB26-00/01 SB29-00/01 SB04-00/01 MW-7/MW-8 SB01A/B SB09A/B SB10A/B SB02-00/01 SB08-00/01 SB05A/B SB31-00/01 SB15-00/01 SB04A/B SB02A/B SB06A/B SB25-00/01 SB07A/B TP-03 SB05A/B SB08A/B SB23-00/01 SB30-00/01 SB21-00/01 MW-10 MW-09 LCH116 LCH114 LCH112 LCH110 LCH115 LCH113 LCH111 LCH108

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF EPA REGION IX PRG INDUSTRIAL SOIL VALUES

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

LEGEND

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- APPROXIMATE NON-TCRA REMOVAL AREA

120 0 60 120
1 inch = 120 ft.

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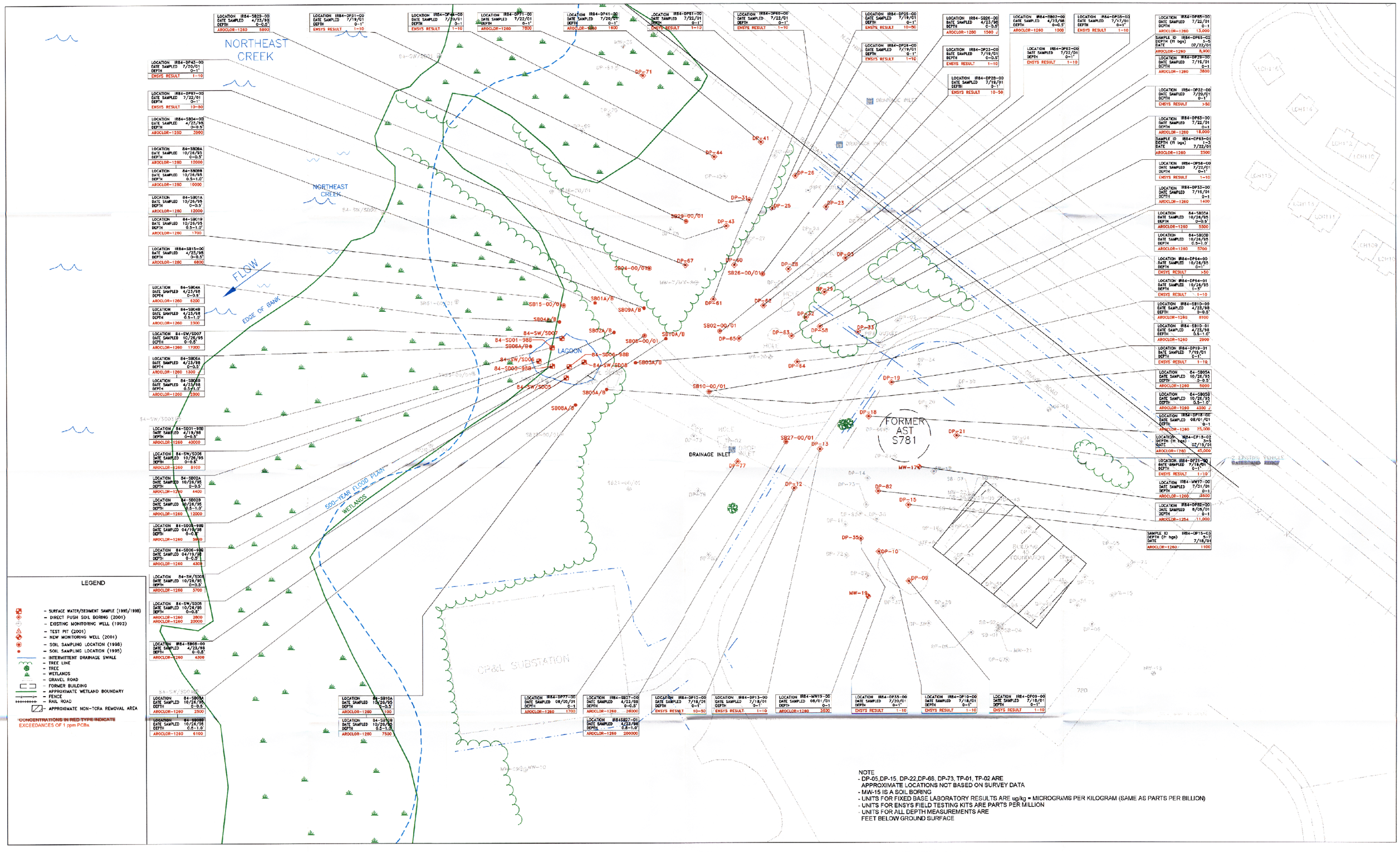
FIGURE 2-3
EXCEEDANCES OF INDUSTRIAL PRGs IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



REVISIONS

DRAWN .
REVIEWED .
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CADD# 2219533F
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NORTH

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania

Baker
Baker Environmental, Inc.

EXCEEDANCES OF PCBs (1 ppm) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

SCALE 1" = 50'

DATE JANUARY 2002

FIGURE NO.
2-4

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LOCATION	IR84-DP25-00
DATE SAMPLED	7/19/01
DEPTH	0-1'
ENSYS RESULT	10-50

LOCATION	IR84-DP28-00
DATE SAMPLED	7/19/01
DEPTH	0-1'
ENSYS RESULT	10-50

LOCATION	IR84-DP67-00
DATE SAMPLED	7/22/01
DEPTH	0-1'
ENSYS RESULT	10-50

LOCATION	84-SB01A
DATE SAMPLED	10/26/95
DEPTH	0-0.5'
AROCLOR-1260	12000

LOCATION	84-SB09A
DATE SAMPLED	10/26/95
DEPTH	0-0.5'
AROCLOR-1260	12000

LOCATION	84-SB09B
DATE SAMPLED	10/26/95
DEPTH	0.5-1.0'
AROCLOR-1260	10000

LOCATION	84-SB02B
DATE SAMPLED	10/26/95
DEPTH	0.5-1.0'
AROCLOR-1260	12000

LOCATION	84-SD01-98B
DATE SAMPLED	4/19/98
DEPTH	0-0.5'
AROCLOR-1260	40000

LOCATION	84-SW/SD07
DATE SAMPLED	10/26/95
DEPTH	0-0.5'
AROCLOR-1260	17000

LOCATION	84-SW/SD05
DATE SAMPLED	10/26/95
DEPTH	0-0.5'
AROCLOR-1260	20000

LOCATION	IR84-DP32-00
DATE SAMPLED	7/20/01
DEPTH	0-1'
ENSYS RESULT	>50

LOCATION	IR84-DP63-00
DATE SAMPLED	7/22/01
DEPTH	0-1'
AROCLOR-1260	18,000

LOCATION	IR84-DP65-00
DATE SAMPLED	7/22/01
DEPTH	0-1'
AROCLOR-1260	13,000

LOCATION	IR84-DP64-00
DATE SAMPLED	7/22/01
DEPTH	0-1'
ENSYS RESULT	>50

LOCATION	IR84-DP18-00
DATE SAMPLED	08/01/01
DEPTH	0-1'
AROCLOR-1260	25,000

SAMPLE ID	IR84-DP18-02
DEPTH (ft bgs)	3-5
DATE	07/19/01
AROCLOR-1260	45,000

LOCATION	IR84-DP82-00
DATE SAMPLED	8/05/01
DEPTH	0-1'
AROCLOR-1254	11,000

LOCATION	IR84-SB27-00
DATE SAMPLED	4/23/98
DEPTH	0-0.5'
AROCLOR-1260	26000

LOCATION	IR84-SB27-01
DATE SAMPLED	4/23/98
DEPTH	0.5-1.0'
AROCLOR-1260	200000

LOCATION	IR84-DP12-00
DATE SAMPLED	7/18/01
DEPTH	0-1'
ENSYS RESULT	10-50

ALL DATA IS IN UNITS OF ug/kg, EXCEPT
ENSYS RESULTS WHICH ARE IN UNITS OF mg/kg.

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)
- ENSYS RESULTS IN PARTS PER MILLION

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF 10 ppm PCBs.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD
- APPROXIMATE NON-TCRA REMOVAL AREA

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)

120 0 60 120
1 inch = 120 ft.

Baker
Baker Environmental, Inc.

FIGURE 2-5
EXCEEDANCES OF PCBs (10 ppm) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

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NORTHEAST CREEK

LOCATION IR84-DP25-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION IR84-DP28-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION IR84-DP67-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION 84-SD01-98B
DATE SAMPLED 4/19/98
DEPTH 0-0.5'
AROCLOR-1260 40000

LOCATION IR84-DP32-00
DATE SAMPLED 7/20/01
DEPTH 0-1'
ENSYS RESULT >50

LOCATION IR84-DP64-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT >50

LOCATION IR84-DP18-00
DATE SAMPLED 08/01/01
DEPTH 0-1'
AROCLOR-1260 25,000

SAMPLE ID IR84-DP18-02
DEPTH (ft bgs) 3-5
DATE 07/19/01
AROCLOR-1260 45,000

LOCATION IR84-SB27-00
DATE SAMPLED 4/23/98
DEPTH 0-0.5'
AROCLOR-1260 26000

LOCATION IR84-SB27-01
DATE SAMPLED 4/23/98
DEPTH 0.5-1.0'
AROCLOR-1260 200000

LOCATION IR84-DP12-00
DATE SAMPLED 7/18/01
DEPTH 0-1'
ENSYS RESULT 10-50

ALL DATA IS IN UNITS OF ug/kg, EXCEPT ENSYS RESULTS WHICH ARE IN UNITS OF mg/kg.

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)
- ENSYS RESULTS IN PARTS PER MILLION

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF 25 ppm PCBs.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD
- APPROXIMATE NON-TCRA REMOVAL AREA

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)

120 0 60 120
1 inch = 120 ft.

Baker
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FIGURE 2-6
EXCEEDANCES OF PCBs (25 ppm) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\GRAPHICS\CAD\FS 2219529F

NORTHEAST CREEK

N.C. HWY 24

RAILROAD

DRAINAGE INLET

PIPE OUTLET

PIPE

GRAVEL ROAD

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

LAGOON

DRAINAGE INLET

FORMER AST S781

2 EXISTING VEHICLE GATES AND FENCE

BUILDING 45 FOUNDATION

CP&L SUBSTATION

780

LOCATION	IR84-DP32-00
DATE SAMPLED	07-20-2001
DEPTH	0-1'
ENSYS RESULT	>50

LOCATION	IR84-DP64-00
DATE SAMPLED	07-22-2001
DEPTH	0-1'
ENSYS RESULTS	>50

LOCATION	IR84SB27-01
DATE SAMPLED	04-23-1998
DEPTH	0.5-1.0'
AROCLOR-1260	200000

ALL DATA IS IN UNITS OF ug/kg, EXCEPT
ENSYS RESULTS WHICH ARE IN UNITS OF mg/kg.

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)
- ENSYS RESULTS IN PARTS PER MILLION

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF 50 ppm PCBs.

120 0 60 120
1 inch = 120 ft.

Baker
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LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 2-7
EXCEEDANCES OF PCBs (50 ppm) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\GRAPHICS\CAD\FS 2219530F

NORTHEAST CREEK

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

N.C. HWY 24

RAILROAD

DRAINAGE INLET

DRAINAGE INLET

PIPE OUTLET

PIPE OUTLET

PIPE

PIPE

DITCH

DITCH

LAGOON

PIPE OUTLET

GRAVEL ROAD

GRAVEL ROAD

2 EXISTING VEHICLE GATES AND FENCE

FORMER AST S781

BUILDING 45 FOUNDATION

780

CP&L SUBSTATION

DRAINAGE INLET

MW-23

DP-84 DP-71

DP-70

DP-69

DP-41 DP-40

DP-44

DP-42

DP-26

DP-31

DP-25 DP-23

DP-43

DP-24 DP-22

DP-68

DP-27

DP-67 DP-60

DP-28

DP-03

DP-01

DP-59

DP-29

DP-62

DP-61

DP-58

DP-33

DP-02

DP-63

DP-65

DP-34

MW-20

DP-64

DP-19

DP-30

DP-20

DP-18

DP-66

DP-21

DP-04

MW-22

DP-81

DP-14

MW-17

DP-17

SB-08

DP-53

DP-73

DP-82

SB-07

SB-05

DP-83

DP-15

DP-56

DP-45

SB-06

DP-54

DP-11

DP-36

DP-16

DP-55

DP-35

DP-72

DP-10

DP-52

DP-47

DP-05

DP-74

DP-57

DP-09

DP-51

DP-48

DP-75

MW-19

DP-39

DP-49

MW-15

DP-37

SB-03

DP-76

DP-50

DP-38

SB-02

SB-04

DP-06

DP-08

SB-01

MW-21

DP-07

MW-18

DP-86

DP-78

DP-77

DP-12

DP-79

MW-10

MW-09

SB28-00/01

SB29-00/01

SB26-00/01

MW-7/MW-8

SB04-00/01

SB01A/B

SB09A/B

SB31-00/01

SB15-00/01

SB04A/B

SB02A/B

SB10A/B

SB02-00/01

SB06A/B

SB08-00/01

SB03A/B

SB07A/B

SB25-00/01

TP-03

SB05A/B

SB08A/B

SB23-00/01

SB30-00/01

SB21-00/01

SB27-00/01

TP-02

SB11-00/01

LCH116

LCH114

LCH112

LCH110

LCH108

LCH111

LCH109

ALL DATA IS IN UNITS OF ug/kg, EXCEPT ENSYS RESULTS WHICH ARE IN UNITS OF mg/kg.

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF 100 ppm PCBs.

LOCATION	IR84SB27-01
DATE SAMPLED	4/23/98
DEPTH	0.5-1.0'
AROCLOR-1260	200000

120 0 60 120

1 inch = 120 ft.

Baker

Baker Environmental, Inc.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 2-8
EXCEEDANCES OF PCBs (100 ppm) IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\GRAPHICS\CAD\FS 2219537F

NORTHEAST CREEK

N.C. HWY 24

RAILROAD

DRAINAGE INLET

PIPE OUTLET

FLOW

EDGE OF BANK

WETLANDS

500-YEAR FLOOD PLAIN

GRAVEL ROAD

DRAINAGE INLET

FORMER AST S781

BUILDING 45 FOUNDATION

CP&L SUBSTATION

2 EXISTING VEHICLE GATES AND FENCE

LOCATION IR84-DP31-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP43-00
DATE SAMPLED 7/20/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP50-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP67-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION 84-SB01A
DATE SAMPLED 10/26/95
DEPTH 0-0.5'
AROCLOR-1260 12000

LOCATION 84-SB09A
DATE SAMPLED 10/26/95
DEPTH 0-0.5'
AROCLOR-1260 12000

LOCATION 84-SB09B
DATE SAMPLED 10/26/95
DEPTH 0.5-1.0'
AROCLOR-1260 10000

LOCATION 84-SW/SD07
DATE SAMPLED 10/26/95
DEPTH 0-0.5'
AROCLOR-1260 17000

LOCATION 84-SD01-98B
DATE SAMPLED 4/19/98
DEPTH 0-0.5'
AROCLOR-1260 40000

LOCATION 84-SW/SD06
DATE SAMPLED 10/26/95
DEPTH 0-0.5'
AROCLOR-1260 8100

LOCATION 84-SW/SD05
DATE SAMPLED 10/26/95
DEPTH 0-0.5'
AROCLOR-1260 20000

LOCATION 84-SB02B
DATE SAMPLED 10/26/95
DEPTH 0.5-1.0'
AROCLOR-1260 12000

LOCATION IR84-SB10-00
DATE SAMPLED 4/23/98
DEPTH 0-0.5'
AROCLOR-1260 8100

LOCATION IR84-DP71-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
AROCLOR-1260 7800

LOCATION IR84-DP44-00
DATE SAMPLED 7/20/01
DEPTH 0-1
ENSYS RESULT 1-10

LOCATION IR84-DP26-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP25-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION IR84-DP23-00
DATE SAMPLED 7/19/01
DEPTH 0-0.5'
ENSYS RESULT 1-10

LOCATION IR84-DP28-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 10-50

LOCATION IR84-DP03-00
DATE SAMPLED 7/17/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP61-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP62-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP32-00
DATE SAMPLED 7/20/01
DEPTH 0-1'
ENSYS RESULT >50

LOCATION IR84-DP58-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP63-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
AROCLOR-1260 18,000

LOCATION IR84-DP65-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
AROCLOR-1260 13,000

SAMPLE ID IR84-DP65-02
DEPTH (ft bgs) 3-5
DATE 07/22/01
AROCLOR-1260 8,900

LOCATION IR84-DP64-00
DATE SAMPLED 7/22/01
DEPTH 0-1'
ENSYS RESULT >50

LOCATION IR84-DP64-01
DATE SAMPLED 10/26/95
DEPTH 1-3'
ENSYS RESULT 1-10

LOCATION IR84-DP21-00
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP19-01
DATE SAMPLED 7/19/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP18-00
DATE SAMPLED 08/01/01
DEPTH 0-1'
AROCLOR-1260 25,000

SAMPLE ID IR84-DP18-02
DEPTH (ft bgs) 3-5
DATE 07/19/01
AROCLOR-1260 45,000

LOCATION IR84-DP13-00
DATE SAMPLED 7/18/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP09-00
DATE SAMPLED 7/18/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP10-00
DATE SAMPLED 7/18/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP82-00
DATE SAMPLED 8/05/01
DEPTH 0-1'
AROCLOR-1254 11,000

LOCATION IR84-DP15-03
DATE SAMPLED 07-18-2001
DEPTH 5-7'
TOTAL PETROLEUM HYDROCARBONS (ug/kg)
Diesel Range Organics 5,500,000
Gasoline Range Organics 580,000

LOCATION IR84-SB27-00
DATE SAMPLED 4/23/98
DEPTH 0-0.5'
AROCLOR-1260 26000

LOCATION IR84-SB27-01
DATE SAMPLED 4/23/98
DEPTH 0.5-1.0'
AROCLOR-1260 200000

LOCATION IR84-DP35-00
DATE SAMPLED 7/20/01
DEPTH 0-1'
ENSYS RESULT 1-10

LOCATION IR84-DP12-00
DATE SAMPLED 7/18/01
DEPTH 0-1'
ENSYS RESULT 10-50

ALL DATA IS IN UNITS OF ug/kg, EXCEPT
ENSYS RESULTS WHICH ARE IN UNITS OF mg/kg.

NOTE
- DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA
- MW-15 IS A SOIL BORING
- ug/kg = MICROGRAMS PER KILOGRAM (SAME AS PARTS PER BILLION)
- ENSYS RESULTS IN PARTS PER MILLION

CONCENTRATIONS IN RED TYPE ARE EXCEEDANCES OF RECREATIONAL REMEDIAL GOALS.

120 0 60 120
1 inch = 120 ft.

Baker
Baker Environmental, Inc.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- GRAVEL ROAD
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- FENCE
- RAIL ROAD
- APPROXIMATE NON-TCRA REMOVAL AREA

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)

FIGURE 2-9
EXCEEDANCES OF RECREATIONAL REMEDIAL GOALS IN SOIL
SITE 84 FEASIBILITY STUDY
CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219500FBWP.dwg (Figure 4-1)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 1 ppm PCBs, TPH, AND/OR RESIDENTIAL PRG CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. EXCAVATED WETLAND SOILS SHALL BE SPREAD OUT OVER THE UPLAND CONTAMINATED SOIL AREA TO DRY PRIOR TO DISPOSAL AT THE BASE LANDFILL.
5. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
6. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
7. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
8. RESTORE IMPACTED WETLANDS AND REVEGETATE ALL DISTURBED AREAS.
9. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
10. MW-15 IS A SOIL BORING.

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

2 EXISTING VEHICLE GATES AND FENCE

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DIRT ROAD

DRAINAGE INLET

PIPE OUTLET

FORMER AST S781

BUILDING 45 FOUNDATION

CP&L SUBSTATION

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

FLOW

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

Baker
Baker Environmental, Inc.

FIGURE 4-1
RAA 2 - EXCAVATION AND LANDFILL DISPOSAL HIGH-OCCUPANCY LAND USE, NO ACCESS RESTRICTIONS SITE 84 FEASIBILITY STUDY CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219500FBWP.dwg (Figure 4-2)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 1 ppm PCBs, TPH, AND/OR RESIDENTIAL PRG CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN OR FENCED.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
7. REVEGETATE ALL DISTURBED AREAS.
8. INSTALL FENCE AROUND WETLANDS AND WOODED AREA AS SHOWN.
9. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
10. MW-15 IS A SOIL BORING.

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

2 EXISTING VEHICLE GATES AND FENCE

EXISTING AIR SPARGING/ SVE SYSTEM

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DIRT ROAD

BUILDING 45 FOUNDATION

FORMER AST S781

DRAINAGE INLET

PIPE OUTLET

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

FLOW

CP&L SUBSTATION

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- PROPOSED FENCE
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

Baker
Baker Environmental, Inc.

FIGURE 4-2
RAA 2a - EXCAVATION AND LANDFILL DISPOSAL HIGH-OCCUPANCY LAND USE, ACCESS RESTRICTIONS SITE 84 FEASIBILITY STUDY CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219502FBWP.dwg (Figure 4-3)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 10 ppm PCBs AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. SOIL SAMPLES SHOWN IN BLUE EXCEED 1 ppm PCBs, TPHs AND/OR RESIDENTIAL PRG CLEANUP GOALS AND SHALL BE CAPPED.
3. WETLAND SOILS NEAR DP-84 AND DP-71 SHALL BE EXCAVATED, DEWATERED, AND PLACED WITHIN THE CAP AREA.
4. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
5. REMAINING EXCAVATED CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
6. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
7. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
8. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN PRIOR TO INSTALLING CAP.
9. RESTORE WETLANDS AND REVEGETATE ALL DISTURBED AREAS.
10. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
11. MW-15 IS A SOIL BORING.

EXCAVATE CONTAMINATED SOIL AND PLACE WITHIN CAP AREA. RESTORE IMPACTED WETLANDS.

APPROXIMATE LOCATION OF TEMPORARY ACCESS ROAD

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LIMITS OF CAP

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

2 EXISTING VEHICLE GATES AND FENCE

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DRAINAGE INLET

PIPE OUTLET

FLOW

500-YEAR FLOOD PLAIN

WETLANDS

CP&L SUBSTATION

BUILDING 45 FOUNDATION

FORMER BUILDING

120 0 60 120
1 inch = 120 ft.

LEGEND

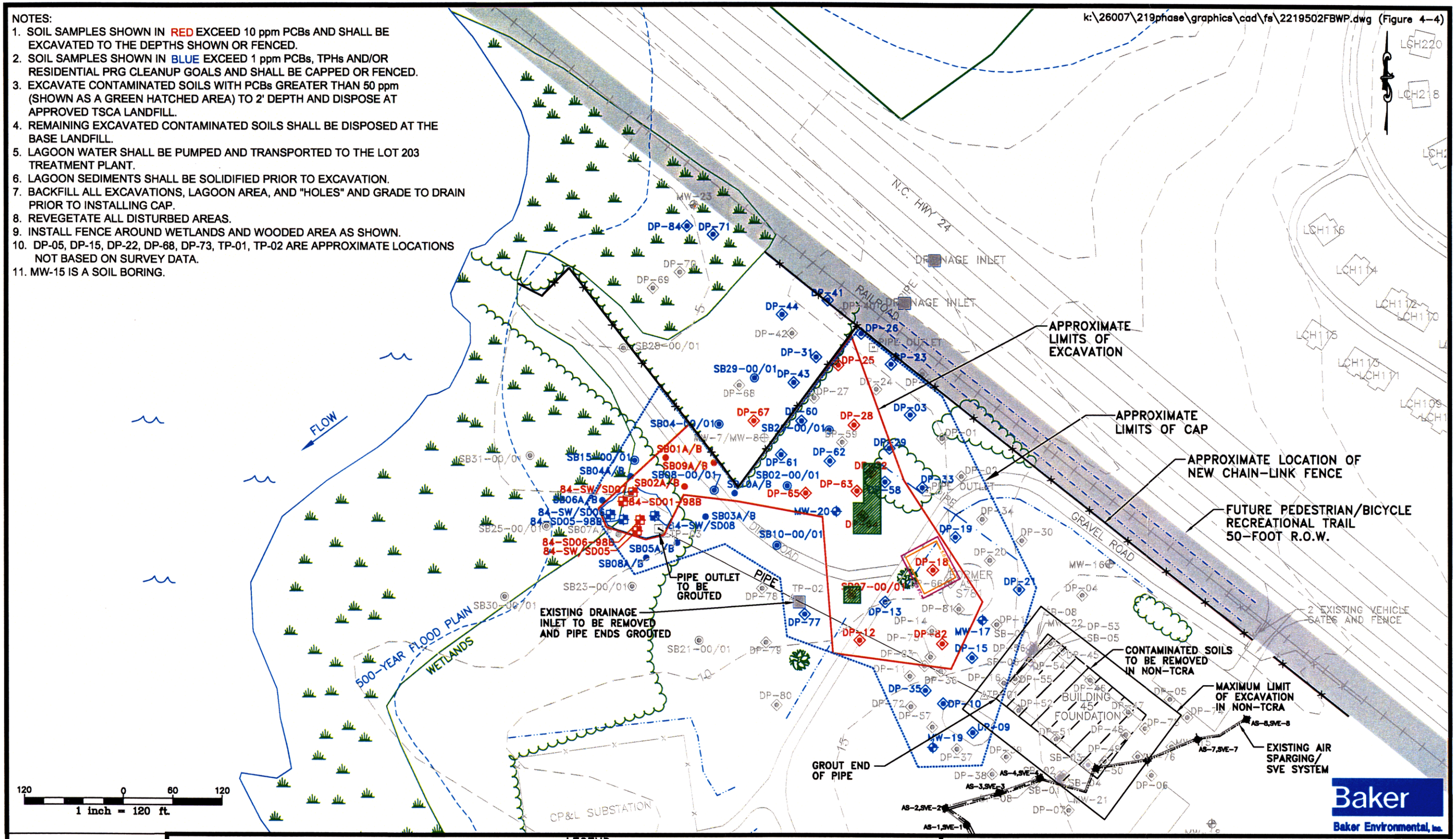
- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- PROPOSED FENCE
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- APPROX. LIMITS OF CAP
- APPROX. NON-TCRA REMOVAL AREA

Baker
Baker Environmental, Inc.

FIGURE 4-3
RAA 3 - EXCAVATION AND CAPPING
HIGH-OCCUPANCY LAND USE, NO ACCESS RESTRICTIONS
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219502FBWP.dwg (Figure 4-4)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 10 ppm PCBs AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN OR FENCED.
2. SOIL SAMPLES SHOWN IN BLUE EXCEED 1 ppm PCBs, TPHs AND/OR RESIDENTIAL PRG CLEANUP GOALS AND SHALL BE CAPPED OR FENCED.
3. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
4. REMAINING EXCAVATED CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
5. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
6. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
7. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN PRIOR TO INSTALLING CAP.
8. REVEGETATE ALL DISTURBED AREAS.
9. INSTALL FENCE AROUND WETLANDS AND WOODED AREA AS SHOWN.
10. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
11. MW-15 IS A SOIL BORING.



LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- PROPOSED FENCE
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- APPROX. LIMITS OF CAP
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 4-4
RAA 3a - EXCAVATION AND CAPPING HIGH-OCCUPANCY LAND USE, ACCESS RESTRICTIONS SITE 84 FEASIBILITY STUDY CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker
Baker Environmental, Inc.

k:\26007\219phase\graphics\cad\fs\2219540F.dwg (Figure 4-5)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 10 ppm PCBs, TPH, AND/OR INDUSTRIAL PRG CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
7. REVEGETATE ALL DISTURBED AREAS.
8. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
9. MW-15 IS A SOIL BORING.

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

APPROXIMATE LIMITS OF SITE PERIMETER FENCE

2 EXISTING VEHICLE GATES AND FENCE

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DRIVE

DRAINAGE INLET

PIPE OUTLET

FORMER BUILDING 45 FOUNDATION

CP&L SUBSTATION

EDGE OF BANK

FLOW

500-YEAR FLOOD PLAIN

WETLANDS

LAGOON

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

FIGURE 4-5
RAA 4 - EXCAVATION AND LANDFILL DISPOSAL
LOW-OCCUPANCY LAND USE
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

Baker Environmental, Inc.

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 25 ppm PCBs, TPH, AND/OR INDUSTRIAL PRG CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
7. REVEGETATE ALL DISTURBED AREAS.
8. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
9. MW-15 IS A SOIL BORING.

k:\26007\219phase\graphics\cad\fs\2219504FBWP.dwg (Figure 4-6)

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

2 EXISTING VEHICLE GATES AND FENCE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

APPROXIMATE LIMITS OF SITE PERIMETER FENCE

PIPE OUTLET TO BE GROUTED

PIPE

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DRAINAGE INLET

PIPE OUTLET

DIRT ROAD

FORMER BUILDING 45 FOUNDATION

CP&L SUBSTATION

LAGOON

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- 1.0 FT. – EXCAVATE TO 1' DEPTH
- 3.0 FT. – EXCAVATE TO 3' DEPTH
- 5.0 FT. – EXCAVATE TO 5' DEPTH
- 7.0 FT. – EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

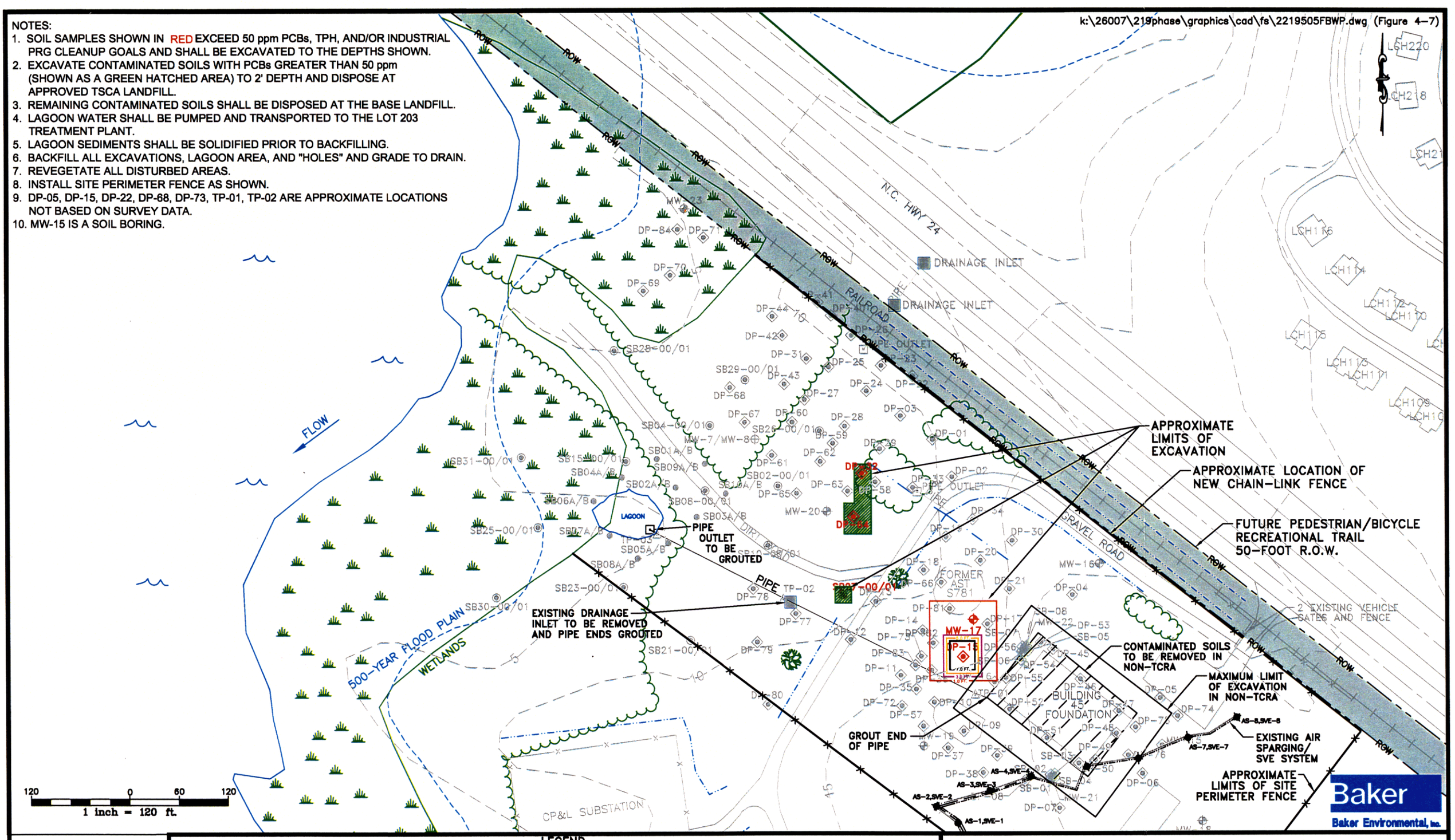
Baker
Baker Environmental, Inc.

FIGURE 4-6
RAA 5 - HOT SPOT REMOVAL AND INSTITUTIONAL CONTROLS LOW-OCCUPANCY LAND USE SITE 84 FEASIBILITY STUDY CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219505FBWP.dwg (Figure 4-7)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED 50 ppm PCBs, TPH, AND/OR INDUSTRIAL PRG CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO BACKFILLING.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
7. REVEGETATE ALL DISTURBED AREAS.
8. INSTALL SITE PERIMETER FENCE AS SHOWN.
9. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
10. MW-15 IS A SOIL BORING.



LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- PROPOSED FENCE
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

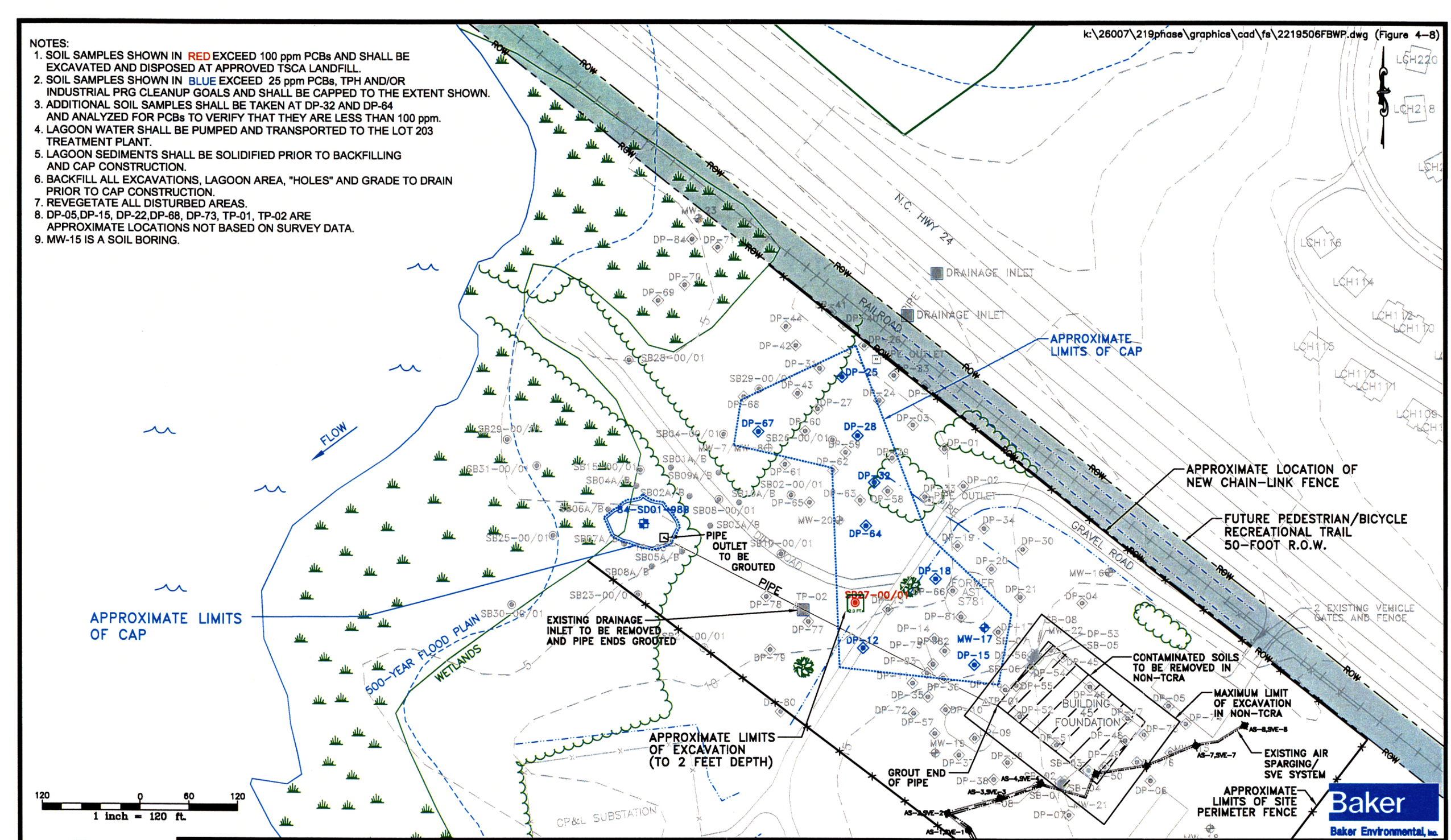
Baker Environmental, Inc.

FIGURE 4-7
RAA 6 - HOT SPOT REMOVAL AND FENCING LOW-OCCUPANCY LAND USE
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219506FBWP.dwg (Figure 4-8)

NOTES:

1. SOIL SAMPLES SHOWN IN RED EXCEED 100 ppm PCBs AND SHALL BE EXCAVATED AND DISPOSED AT APPROVED TSCA LANDFILL.
2. SOIL SAMPLES SHOWN IN BLUE EXCEED 25 ppm PCBs, TPH AND/OR INDUSTRIAL PRG CLEANUP GOALS AND SHALL BE CAPPED TO THE EXTENT SHOWN.
3. ADDITIONAL SOIL SAMPLES SHALL BE TAKEN AT DP-32 AND DP-64 AND ANALYZED FOR PCBs TO VERIFY THAT THEY ARE LESS THAN 100 ppm.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO BACKFILLING AND CAP CONSTRUCTION.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, "HOLES" AND GRADE TO DRAIN PRIOR TO CAP CONSTRUCTION.
7. REVEGETATE ALL DISTURBED AREAS.
8. DP-05,DP-15, DP-22,DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
9. MW-15 IS A SOIL BORING.



120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- APPROXIMATE NON-TCRA REMOVAL AREA
- APPROXIMATE LIMITS OF CAP

- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)

Baker
Baker Environmental, Inc.

FIGURE 4-8
RAA 7 - HOT SPOT REMOVAL AND CAPPING LOW-OCCUPANCY LAND USE SITE 84 FEASIBILTY STUDY CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219539F.dwg (Figure 4-9)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED RISK-BASED RECREATIONAL CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. EXCAVATED WETLAND SOILS SHALL BE SPREAD OUT OVER THE UPLAND CONTAMINATED SOIL AREA TO DRY PRIOR TO DISPOSAL AT THE BASE LANDFILL.
5. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
6. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
7. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
8. RESTORE IMPACTED WETLANDS AND REVEGETATE ALL DISTURBED AREAS.
9. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
10. MW-15 IS A SOIL BORING.

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

2 EXISTING VEHICLE GATES AND FENCE

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

GROUT END OF PIPE

N.C. HWY 24

RAILROAD

GRAVEL ROAD

DRAINAGE INLET

PIPE OUTLET

BUILDING 45 FOUNDATION

FORMER UST S781

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

CP&L SUBSTATION

FLOW

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

Baker
Baker Environmental, Inc.

FIGURE 4-9
RAA 8 - EXCAVATION AND LANDFILL DISPOSAL
RECREATIONAL LAND USE, NO ACCESS RESTRICTIONS
SITE 84 FEASIBILITY STUDY
CTO 0219
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

k:\26007\219phase\graphics\cad\fs\2219539F.dwg (Figure 4-10)

NOTES:
1. SOIL SAMPLES SHOWN IN RED EXCEED RISK-BASED RECREATIONAL CLEANUP GOALS AND SHALL BE EXCAVATED TO THE DEPTHS SHOWN OR FENCED.
2. EXCAVATE CONTAMINATED SOILS WITH PCBs GREATER THAN 50 ppm (SHOWN AS A GREEN HATCHED AREA) TO 2' DEPTH AND DISPOSE AT APPROVED TSCA LANDFILL.
3. REMAINING CONTAMINATED SOILS SHALL BE DISPOSED AT THE BASE LANDFILL.
4. LAGOON WATER SHALL BE PUMPED AND TRANSPORTED TO THE LOT 203 TREATMENT PLANT.
5. LAGOON SEDIMENTS SHALL BE SOLIDIFIED PRIOR TO EXCAVATION.
6. BACKFILL ALL EXCAVATIONS, LAGOON AREA, AND "HOLES" AND GRADE TO DRAIN.
7. REVEGETATE ALL DISTURBED AREAS.
8. INSTALL FENCE AROUND WETLANDS AND WOODED AREA AS SHOWN.
9. DP-05, DP-15, DP-22, DP-68, DP-73, TP-01, TP-02 ARE APPROXIMATE LOCATIONS NOT BASED ON SURVEY DATA.
10. MW-15 IS A SOIL BORING.

INSTALL FENCE AROUND WETLAND/ WOODED AREA

APPROXIMATE LIMITS OF EXCAVATION

APPROXIMATE LOCATION OF NEW CHAIN-LINK FENCE

FUTURE PEDESTRIAN/BICYCLE RECREATIONAL TRAIL 50-FOOT R.O.W.

PIPE OUTLET TO BE GROUTED

EXISTING DRAINAGE INLET TO BE REMOVED AND PIPE ENDS GROUTED

GROUT END OF PIPE

CONTAMINATED SOILS TO BE REMOVED IN NON-TCRA

MAXIMUM LIMIT OF EXCAVATION IN NON-TCRA

EXISTING AIR SPARGING/ SVE SYSTEM

2 EXISTING VEHICLE GATES AND FENCE

N.C. HWY 24

GRAVEL ROAD

RAILROAD

DRAINAGE INLET

FLOW

EDGE OF BANK

500-YEAR FLOOD PLAIN

WETLANDS

CP&L SUBSTATION

BUILDING 45 FOUNDATION

120 0 60 120
1 inch = 120 ft.

LEGEND

- INTERMITTENT DRAINAGE SWALE
- TREE LINE
- TREE
- WETLANDS
- FORMER BUILDING
- APPROXIMATE WETLAND BOUNDARY
- EXISTING FENCE
- RAIL ROAD
- PROPOSED FENCE
- DIRECT PUSH SOIL BORING (2001)
- EXISTING MONITORING WELL (1992)
- TEST PIT (2001)
- NEW MONITORING WELL (2001)
- SOIL SAMPLING LOCATION (1998)
- SOIL SAMPLING LOCATION (1995)
- SURFACE WATER/SEDIMENT SAMPLE (1995/1998)
- PCBs GREATER THAN 50 ppm
- EXCAVATE TO 1' DEPTH
- EXCAVATE TO 3' DEPTH
- EXCAVATE TO 5' DEPTH
- EXCAVATE TO 7' DEPTH
- APPROXIMATE NON-TCRA REMOVAL AREA

Baker
Baker Environmental, Inc.

FIGURE 4-10
RAA 8a - EXCAVATION AND LANDFILL DISPOSAL RECREATIONAL LAND USE, ACCESS RESTRICTIONS SITE 84 FEASIBILITY STUDY CTO 0219

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

MW-23

SAMPLE ID	IR84-MW23-01C
SAMPLE DATE	08-06-2001
METALS (mg/L)	
Aluminum	0.52
Iron	25.8
Manganese	0.066

SAMPLE ID	IR84-MW20-01C
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Iron	24.9
Manganese	0.16
PESTICIDES (ug/L)	
Heptachlor epoxide	0.03J

SAMPLE ID	IR84-MW20-01CD
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Iron	24.1
Manganese	0.16

SAMPLE ID	IR84-MW08-01C
SAMPLE DATE	08-06-2001
METALS (mg/L)	
Arsenic	0.03
Iron	67.7
Manganese	0.18
Thallium	0.0057 J

NORTHEAST CREEK

EDGE OF BANK

SAMPLE ID	IR84-MW07-01C
SAMPLE DATE	08-06-2001
METALS (mg/L)	
Arsenic	0.013
Iron	51.1
Manganese	0.45

GW08

GW07

NC HWY 24

RAILROAD

HOLE

HOLE

HOLE

HOLE

MW-20

SAMPLE ID	IR84-MW16-01C
SAMPLE DATE	08-04-2001
METALS (mg/L)	
Iron	0.18

SAMPLE ID	IR84-MW22-01C
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Aluminum	0.52
Iron	0.37

SAMPLE ID	IR84-MW17-01C
SAMPLE DATE	08-06-2001
METALS (mg/L)	
Aluminum	0.73
Antimony	0.011 J
Iron	1
Thallium	0.0054 J

LAGOON

HOLE

MW-16

HOLE

DROP INLET

FORMER AST S781

MW-17

SAMPLE ID	AST781-GW03-98B
SAMPLE DATE	4/23/98
VOLATILES (ug/L)	
Benzene	3.4 J

GW03

GW04

S779

MW-22

S792

S791

BLDG. 45

S938

SAMPLE ID	AST781-GW04-98B
SAMPLE DATE	4/23/98
VOLATILES (ug/L)	
Benzene	1.5 J

SAMPLE ID	IR84-MW19-01C
SAMPLE DATE	08-04-2001
METALS (mg/L)	
Aluminum	0.58
Iron	0.39

TELEPHONE BOXES

SAMPLE ID	IR84-MW21-01C
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Aluminum	0.56
Iron	0.33
Manganese	0.069

SAMPLE ID	AST781-GW11-98B
SAMPLE DATE	4/23/98
VOLATILES (ug/L)	
Chloroform	16

MW-19

S937

SAMPLE ID	AST781-GW12-98B
SAMPLE DATE	4/23/98
VOLATILES (ug/L)	
Chloroform	16

MW-21

SAMPLE ID	IR84-MW18-01C
SAMPLE DATE	08-04-2001
METALS (mg/L)	
Aluminum	0.54
Iron	0.53
Manganese	0.24
PESTICIDES (ug/L)	
Gamma-Chlordane	0.04J

SAMPLE ID	IR84-MW10-01C
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Aluminum	0.55

CP&L SUBSTATION

GW11

GW12

780

MW-18

SAMPLE ID	IR84-MW09-01C
SAMPLE DATE	08-05-2001
METALS (mg/L)	
Aluminum	0.44
Iron	0.74

MW-09

MW-10

100 0 50 100

1 inch = 100 ft.

Baker

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MONITORING WELLS IN RED ARE INCLUDED IN THE GROUNDWATER MONITORING PROGRAM.

CONCENTRATIONS IN RED TEXT EXCEED THE FEDERAL MCL.

CONCENTRATIONS IN GREEN TEXT EXCEED THE NC WQS.

CONCENTRATIONS IN PURPLE TEXT EXCEED BOTH THE MCL AND NC WQS.

LEGEND

- INTERMITTENT DRAINAGE SWELL
- TREE LINE
- GRAVEL ROAD
- MONITORING WELL (2001)
- MONITORING WELL (1992)

FIGURE 4-11

GW RAA 2: GROUNDWATER MONITORING AND INSTITUTIONAL CONTROLS

SITE 84 - FEASIBILITY STUDY

CTO - 0219

MARINE CORPS BASE, CAMP LEJEUNE

NORTH CAROLINA